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ABSTRACT

More than 60 papers presented at the 1987 Pacific Telecommunications Council (PTC) conference on telecommunications needs, primarily in and around the Pacific region, are included in this volume. Contributions from major industry user groups, governments, developmental institutions, and the small user are represented. Four keynote addresses open the proceedings: (1) "The New Zealand Communications Environment: Goals, Demands, Pressures" (Jonathan Hunt); (2) "Consolidating Communication Services in a Multi-National Environment" (Edmond J. Blausten); (3) "Telecommunications and the Emerging Global Corporation" (R. W. Sturm); and (4) "International Users: Their Place in Planning" (Peter Smith). Papers are then presented chronologically to reflect the focus of the three conference days. Papers from the first day focus on large business and industrial users, including users and providers, user perspectives, national developments, and technical applications. Government and public users were examined on the second day, including public and private networks, using the broadcast medium, shared tenant services and teleports, and using information systems. National developments in Chile (paper is in Spanish), Canada, Japan, and Korea are presented in this section. Papers from the final day look at rural, remote, and small users, including the new environment, educational uses, and applications of small aperture earth stations. (MES)

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PTC'87

Edited by
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Telecommunications—Asia, Americas, Pacific: PTC'87 Proceedings

PTC'87
Pacific Telecommunications Users: A Spectrum of Requirements

January 18-21, 1987
Sheraton Waikiki Hotel
Honolulu, Hawaii

Edited by
Dan J. Wedemeyer and Mary Sue Bissell

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The Pacific Telecommunications Council

PTC'87 is organized by the Pacific Telecommunications Council, an international, non-governmental, non-profit organization. The council is regional in nature, embracing members from all the countries that play a role in the development of Pacific telecommunications. Its members are dedicated to promoting the understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere — North, Central, and South America; East, South, and Southeast Asia; Australia, New Zealand, Melanesia, Micronesia, and Polynesia.

Foreword

The Ninth Annual Pacific Telecommunications Conference, PTC'87, focuses on users and user requirements.

While users have been a central concern of PTC for nearly a decade, resource capabilities and technical evolution have been central to many past conferences. However, the evolution toward a digital telecommunication world can only be meaningful if considered in the context of whether these sophisticated technologies serve real needs. Communications needs are best articulated by users.

Contributions to this volume represents a wide range of perspectives. Of the more than one hundred papers submitted to PTC'87, over sixty are represented here. Care has been taken to balance across the "spectrum of needs" in and around the Pacific region. As such, contributions from major industry user groups, governments, and educational institutions, as well as the small user, are found in this volume. The papers are presented chronologically, by conference days.

The distribution of this conference volume will be limited. A hard-cover trade edition will be published after PTC'87 by North-Holland, a branch of Elsevier Science Publishers, B.V. The trade edition will include the contents of this volume along with other papers presented at PTC'87. In addition, a complete summary of the conference activities will be provided.

During the past years, the PTC conference proceedings have become one of the most valuable resources for telecommunication education, research, business and government planning in the region. The works contained here enhance the valuable contributions of the past eight years. The conference organizing committee wishes to thank all of the contributors to the volume and invite you to take full advantage of the activities and professional contacts available at PTC'87.

Mahalo and Aloha,

Dan J. Wedemeyer and Mary Sue Bissell
Co-Editors

Honolulu, 1987

Table of Contents

PAGE

FOREWORD

Sunday, January 18

OPENING PLENARY SESSION

Pacific Overview

KEYNOTERS:

3 ***The New Zealand Communications Environment: Goals, Demands, Pressures***
Jonathan Hunt

11 ***Consolidating Communication Services in a Multi-National Environment***
Edmond J. Blausten

21 ***Telecommunications and the Emerging Global Corporation***
R.W. Sturm

23 ***International Users: Their Place in Planning***
Peter Smith

Monday, January 19

PLENARY:

Large Business & Industrial Users

31 ***Users' Point of View***
Harold Heinze

33 ***Use of Virtual Private Networks to Satisfy Large Users' Needs***
M. Iwama

45 ***Meeting User Requirements: A Networking Perspective***
A.L. Moore

CONCURRENT SESSIONS:

Session 1:
Overviews: Users & Providers

55 ***International Private User Networking: A Business Perspective***
R.T. Butkus, M. Benveniste, and R.W. Ross, Jr.

61 ***PPAC Private Pacific Cable Between the U.S. and Japan***
Dennis W. Elliott

64 ***The FCC's Promotion of International Competition: Has It Helped the User?***
Timothy J. Logue

72 ***The Strategic Management of Telecommunications in the Information Age: A Case Study of Three Large Users***
Charles W. Steinfield, Gary Pizante and Megumi Komiya

80 ***The Global Aspects of ISDN***
David T. Tudge

Session 2:
User Perspectives

87 ***How To Meet the Diversifying User's Requirements: A Strategy for the Provision of New Telecommunication Services***
Masanori Amano

94 ***Cellular Communications, The New Medium: The Los Angeles Experience***
Alex L. Dresser

97 ***Analysis of NTT's Telephone Card Marketing: Case Study of User Participation for Making Successful Telecommunication Products***
Kazuaki Katori

107 ***Catch 22: A Case Study of Hawaiian Tel Company***
Meheroo Jussawalla and Vince Ebata

119 ***A Strategic Perspective for Hawaii's Future Users of Telecommunications***
Patricia Lum and William W. Milks

Session 3:
National Developments

131 ***Results of Selected Experiences with Local Charging Systems and Network Digitalization in Chile***
Carlos Masao Haramoto

142 ***User Impediments: Regulatory Restraints in an Era of Deregulation, The Canadian Situation***
Thomas L. McPhail

PAGE

148 ***Facsimile Communications Via the International Public Switched Telephone Network***
Akifumi Nakao

153 ***Technological Self-Reliance in Korea Telecommunications***
Jung Uck Seo

Session 4:
Technical Applications

159 ***Effectiveness and Problems of Information Network System Using Digital Technology***
Sadao Aoki, Nobuo Sakata and Tsutomu Saito

169 ***The Present Status and Future Trend of Private ISDN Using High Speed Digital Path***
Kazunori Hisajima

174 ***Design and Engineering Guidelines for Effective Network Planning***
John Z. Jacoby and Dominic H. Wong

183 ***Report on the Present Situation of OSI Diffusion Activities in Japan***
Dr. Yutaka Matsushita

193 ***Digital Radio Multiple Access Subscriber System (DRMASS)***
M. Miyake, K. Takeuchi, K. Yamamoto, S. Shinmyo, M. Ogawa and M. Yamauchi

201 ***Statistical Switching Networks for Integrated Services***
Moshe Rozenblit

207 **Videoconference:** Notes

AFTERNOON PLENARY:
Technology Diffusion

209 ***Japan's Telecommunications Industry: Our Present Status and the Challenges We Face***
Namio Hashimoto

217 ***Cultural and Telecommunications Futures in Six Pacific Islands***
Christopher Jones, Barbara Moir and James Dator

227 **Informal Discussion Tables with Keynoters:** Notes

PAGE

229 **Informal Topic Discussion Tables:** Notes

Pacific Islands Round Table: Notes

231 ***Planning the Use of Satellite Transmissions Within the South Pacific Telecommunications Development Programme***
E.J. Wilkinson

Tuesday, January 20

PLENARY:
Governmental & Public Users

241 Lee, Ja-Hon

243 ***Policies of the MPT of Japan Towards the Advanced Information Society***
Minoru Shioya

245 ***User-Driven Services: Who Plays, Who Pays, and Who Calls the Tune***
Diana Lady Dougan

CONCURRENT SESSIONS:

Session 1:
Public & Private Networks

251 ***Using Public Data Networks to Enhance the Functionality of Private Networks***
Harvey Baumel

256 ***Introduction of Digital Loop Carriers in Pacific Basin Countries***
Joseph B. Cheung

260 ***Private Satellite Networks for Business Communications***
H. Allen Ecker

269 ***The Impact of Satellite Technology on The Globe and Mail, Canada's National Newspaper***
D.E. Evans

272 ***Electronic Information Dissemination: Opportunities for Users in the Public Sector***
David Richardson, John Hont and Chris Ballenden

Session 2:
Using the Broadcast Medium

PAGE

279 ***Legal Issues Surrounding International Sports Broadcasting***
Thomas Joseph Cryan and James S. Crane

286 ***Television in Indonesia: Towards a Revolutionary Information Era***
Ishadi Sk

292 ***Remote Commercial Television & Telecommunications in Australia***
James C. Lange

298 ***Getting the News to the Public in Truk: A Telecommunications Perspective***
Eric H. Metzgar

303 ***Australia Pioneers B-MAC for Television Broadcasts by Satellite***
Gerald Moriarty

Session 3:
Shared Tenant Services and Teleports—A Videoconference Discussion:

309 ***One Perspective on Digital Videoconferencing, Shared Tenant Services, the Demand for Teleports and State Regulation***
George E. Darby

Session 4:
Using Information Systems

315 ***Some Experiences in the Field Trial of Videotex Service in Taiwan***
Yu-Huei Jea

320 ***A Value-Added Model of Electronic Mail Utilization***
Paul S. Licker, Peter R. Newsted, and Bernard S. Sheehan

330 ***The Study for the Advanced Use of CAPTAIN—Videotex Information Service in Corporation***
Yurihiko Tamechika and Tomoko Kano

338 ***Electronic Mail and a Private Satellite Network***
Christine Wirth

342 ***The Study for an Advanced Use of Satellite Communication—The Development of the Distributed Videotex Data Base Retrieval System Using Satellite Communication***
Koichi Yamakawa and Keisuke Doi

PAGE

Luncheon Speaker

353 ***Services to Users World-Wide in a Changing Telecommunications Environment:*** *Notes*
Anthony J. Booth

Working Groups:
Background Papers

357 ***Patents, Copyrights and Trade Secrets as Applied to Telecommunications in the United States***
Stephen E. Baldwin and Henry K. Woodward

364 ***All Digital Networks, And How the User Benefits***
Peter J. Cott

366 ***U.S. Technical Data Export License Regulations and National Security***
Fred M. Greguras

373 ***Alternative Telecommunications Financing in Developing Countries***
Norman C. Lerner

375 ***Education at Home Through Teleconferencing***
Helen Sprawls

Wednesday, January 21

PLENARY:

Rural, Remote & Small Users

381 ***INTELSAT: The Pacific and Communications Development***
Joseph N. Pelton

391 ***Rural Telecommunications Requirements in the Philippines***
Rosauro V. Sibal

397 ***Emerging Pacific Island Service Requirements***
Robert M. Engelbardt

CONCURRENT SESSIONS

Session 1:
The New Environment

407 ***Social Impact of Intelligent Telecommunication Networks***
Syed V. Ahamed

PAGE

415 ***Developing the Telecommunications Profession—Certification Program Design***
William Ammentorp, Harry Hurley, Matt Ammentorp and David Hoffman

423 ***A New Work Environment Applied Advanced Telecommunication Facilities—C & C Satellite Office***
Kiichi Fujino and Toshio Terashima

432 ***The Key Aspects of Software Quality and Management Systems***
Kiyoh Nakamura and Mamoru Sugawara

Session 2:
Rural & Remote Users

443 ***Quality Service to Small Communities***
Vasanta Raju, C.S. Mohan, K.R.S. Murthy, R. Sridharan and M.K. Sudarshan

452 ***Rural Telecommunications in Thailand: Experiences from a Project in Progress***
Precha Rugsachart and Duncan Sharp

459 ***AUSSAT—Satellite Services in Australia***
Michael Wagg

Session 3:
Educational Uses

465 ***USPNet Satellite Developments: An Educational Telecommunications Model from the South Pacific—A Personal View from Within***
Marjorie Tuainekore Crocombe

469 ***Open Learning Systems Through Telecommunications***
Glen Farrell and Lucille Pacey

476 ***Telecommunications Technology and Special Education Needs in the Pacific Region***
Deanna Robinson, Richard Zeller, Carl Bybee, and Graham Wagner

478 ***Enriching Classroom Experiences and Career Opportunities Through Telecommunication Technologies: The Global Education TELEclass Project Partnership Model***
John H. Southworth and Carole Ishimaru

486 ***The Impact of Telephone Networks on Rural and Educational Development: Experiences of the AID Rural Satellite Program***
Karen Tietjen, Willard Shaw and Clifford Block

Session 4:
Applications of Small Aperture Earth Stations

PAGE

499 ***Very Small Aperture Terminals (VSAT)—An Overview***
Joseph Freitag, Jr.

505 ***Equatorial Spread Spectrum Technology***
Roger G. Clark

509 ***The Network Monitor and Control of the Mini-Earth Station Networks***
Akira Fujii, Yoshimi Teshigawara, and Hideki Namba

515 ***Application of Millimeter-Wave Satellite Communication to Asia-Oceanian Region and Consideration of Experimental System***
Shunkichi Isobe, Takashi Iida, Yoshiaki Suzuki, Shigetoshi Yoshimoto, Yoshinori Arimoto, Susumu Kitazume, Tatsuya Koike, Hideki Kobayashi, and Akihiko Inoue

521 ***Ku-Band Small Aperture Earth Stations for Cost Effective Communications***
Andrew D. Poole

524 ***Proposed Telecommunications Network Architecture in the Pacific Ocean Region: Satellite Communications System Using Micro Terminals***
H. Yuguchi, S. Endo, M. Ohkawa, and F. Makita

531 **Panel:**
Government, Suppliers' and Users' Perspectives on Arriving at International Standards Agreements: Views from Japan and the U.S.
Notes

533 **Rapporteurs' Summary and Closing Remarks:**
Notes

Sunday, January 18
Opening Plenary Session

Pacific Overview

Keynote Address

"The New Zealand Communications Environment: Goals, Demands, Pressures"

Jonathan Hunt, Minister of Broadcasting
and Postmaster General
New Zealand

Notes

The New Zealand Communications Environment: Goals, Demands, Pressures

Hon Jonathan Hunt
Minister of Broadcasting and
Postmaster General of New Zealand

Introduction

New Zealand is undergoing radical changes. Our economy, our markets, our institutions, our businesses and our way of life are going through a metamorphosis. As Minister in charge of broadcasting and telecommunications services, I am partly responsible for these changes.

When my Government was elected in 1984 my colleagues and I brought to New Zealand a commitment to economic reform. We were concerned by the steady deterioration in the country's economic position after two decades of relative prosperity. Inflation rates of about 15 to 20 percent were not uncommon; our external trade balance position was declining; our traditional export markets were drying up; and the cost of Government and its institutions was an increasing burden on the taxpayers. The previous Government had unsuccessfully and disastrously tried to eliminate these problems by imposing a lengthy wage and price freeze.

The present Labour Government felt that radical changes were needed to reverse the economic slide, and to return New Zealand to the position we once enjoyed as a leader in the OECD stakes. Part of this reform addresses the provision of telecommunications and broadcasting services.

Our policy for economic reform is quite simple; we must be able to compete effectively on world markets. As a relatively small country with a population of 3.3 million, we rely heavily on imported goods to maintain our standard of living Most of our exports are agriculture-based products - meat, butter, wool, and timber.

Until the early 1970s, New Zealand had guarnteed export markets in the United Kingdom and Europe. With the entry of the United Kingdom into the European Common Market in 1972, New Zealand has been progessively shut out of this market. Since then we have been making efforts to diversify our products and markets with some notable successes.

During the last two years, we have taken many steps to ensure that New Zealand business remains competitive on world markets.

One key to overall economic reform lies in improving the efficiency of our state sector. New Zealand's telecommunications services are provided by the state through the New Zealand Post Office. The institutional structures that have evolved during the last 150 years are no longer suited to satisfying today's market needs efficiently. Before mentioning details of this reform, however, I would like to comment briefly on the New Zealand telecommunications market place.

New Zealand's Telecommunications Scene

The theme of this PTC Conference is user requirements for telecommunications services. Users are foremost in our minds in New Zealand as we move to restructure the telecommunications institutions. To compete in the world market place, it is essential that these users have access to the same services as their overseas competitors at a comparable price.

Because of New Zealand's geographic distance from the rest of the world, and its economic dependence on international trade, priority has been given during the past 100 years to establishing high quality telecommunications services. This investment has paid off. We now have one of the highest telephone densities in the world, behind only Sweden, Switzerland, the United States and Denmark. Over 90 percent of all telephone subscribers have subscriber toll dialing. International telephone services are provided by both satellites and undersea cables. Tenders have been called for a fibre optic submarine cable to Australia, to be installed in the early 1990s. Later this year, we shall begin using one of the Australian AUSSAT satellites for domestic communications.

We have made rapid progress in implementing a nationwide digital telecommunications network. More than 10 percent of the switching capacity is now digital and a high capacity digital backbone stretches almost the length of New Zealand which is one thousand miles, or sixteen hundred kilometres from North to South.

In recent years the New Zealand Post Office has introduced an expanded range of services, particularly for data communications. Videotex, electronic messaging and eletronic funds transfer services are now well established. Later this year a mobile telephone service using cellular radio technology will be introduced. Despite a continuing high level of capital investment, however (almost $500 million in the current financial year), the growth in demand has continued to stretch Post Office resources. As a result, delays have arisen in providing some business services in the metropolitan areas.

The telecommunications business of the New Zealand Post Office showed record growth in 1985/86, and high rates of growth in demand are expected to continue at least until the end of this decade. The current shortage of skilled and experienced technical personnel will delay an improvement in service standards.

I would like to talk now about economic reform in our state organisations such as the Post Office. The State-Owned Enterprises Act was passed in Parliament late last year with the objectives of helping to improve the economic performance of the state enterprises and enhancing their accountability.

State-Owned Enterprises

State enterprises undertake one-fifth of New Zealand's investment and produce 12 percent of the national income. Poor performance by state enterprises can seriously impede national economic development and impose a burden on Government finances. Good performance, on the other hand, can help attain Government objectives of more jobs and higher living standards.

After reviewing the performance of state enterprises a number of factors holding them back have been identified. They are:

--- multiple and conflicting objectives, some commerical, some non-commercial;

--- bureaucratic controls on managers that focus on input rather than output;

--- legislative protection from competition and unnecessary legislative contraints;

--- lack of managerial accountability.

The Government has decided to separate the non-commerical functions from the trading activities and make managers of the enterprises responsible for running them as successful businesses. It plans to remove unnecessary barriers to competition so that commerical criteria will provide a fair assessment of managerial performance.

Each enterprise will report to the Board of Directors appointed by the Government, which in turn will report to two Ministers of the Crown who are joint shareholders, one being the Minister of Finance, the other the Minister responsible for the enterprise. The Ministers remain accountable to the House of Representatives.

Each State-Owned Enterprise will be required to submit a Statement of Corporate Intent, including such information as proposed financial structure, rates of return, performance targets and dividend policy. This document will be tabled in Parliament and used to assess the enterprise's performance.

The Post Office is today the largest organisation in New Zealand, employing almost 40,000 people or nearly three percent of the labour force. It has four major areas of business - banking, postal, telecommunications, and agency (including such areas as television-receiver licensing, electoral roll compilation and motor registration).

An independent report on the Post Office which I commissioned in 1985 recommended changes to the Post Office structure. The Government adopted the major recommendation to divide the Post Office into three separate corporations. New Zealand Post, Post Office Bank and the Telecom Corporation will come into being on 1 April 1987. Each will operate according to the principles I outlined earlier for State-Owned Enterprises.

The Telecom Corporation will be the largest of the three new corporations, with some 24,000 staff. It has been the most profitable Post Office business, reporting an after tax profit of about $162 million for the year ended 31 March 1986. An Establishment Board was appointed towards the end of last year, and this board is currently making arrangements for the transition to the new organisational structure.

A timetable has been set for introducing competition in the supply of customer premises equipment, consistent with our policy of removing unnecessary barriers to competition. I expect that competition will help to satisfy market demands for the great diversity of telecommunications equipment now available.

From 1 October 1987 the Post Office's monopoly on the installation and maintenance of house wiring will be relaxed. The competitive supply of telex machines will also be permitted from this date. Commerical premises wiring and the sale of telephones will be permitted from 1 March 1988, and PABX equipment from 1 April 1989. These dates have been set to allow time to develop the necessary technical standards.

Competition in providing basic network services is not being considered at this time because of the complexity of the issues involved. From 1 April 1987, however, restrictions on the shared use of switchboard services will be relaxed. Services which add value to basic network services are already open to competitive supply.

The Royal Commision on Broadcasting

New Zealand has a sophisticated broadcasting system conforming to international standards, operated by highly qualified and experienced staff. The two television channels, and the main radio networks, are provided by the Broadcasting Corporation of New Zealand, a public broadcasting organisation. About 85 percent of the Corporation's funding is provided from advertising, with the balance from licence fees paid by the owners of television sets.

A small number of private radio stations provide an alternative commercial service in some cities, and the Broadcasting Tribunal is presently considering applications for warrants to operate a third regionally-based private television channel.

Broadcasting services in New Zealand are major users of telecommunications radio frequency spectrum, facilities and resources. The Government was mindful of this when it set up a Royal Commission of Inquiry into Broadcasting and Related Telecommunications, early in 1985. The Commission was given very broad terms of reference, and was charged with producing a report and recommendations to set a course for broadcasting development to the end of this century.

A complicating factor was the existence of the private television hearings, which were underway before the Commission started its work. The Commission has assumed throughout its report, however, that a private television service will eventually be set up, and has proceeded on this basis. The task of the Commission has been to examine broadcasting as a system, and to explore the performance of public service broadcasting.

Public broadcasting in New Zealand is in transition, and faces an intensely competitive future. Furthermore, there is much left over from the past. Maori broadcasting, the scope of New Zealand production, educational programming and the impact of satellites on what remains of Radio New Zealand International are all old questions being examined with new interest.

There are two major ways in which a Royal Commission may act. It can launch the process of major change, particularly where a situation has become rigid or intractable. Otherwise, it may make recommendations to adapt a situation which is under strain and faces change. The Commission's recommendations are of the second kind.

Because of its dependence on advertising revenue, New Zealand's public broadcasting system will undergo a period of strain when a private commercial television channel is introduced. A further factor will be the onset of new technical developments, with their financial and social consequences. The rate of change cannot be predicted, but there is no doubt that the developments will occur.

The Royal Commission produced almost 200 recommendations, and obviously I can mention only a few of them. In particular, I should like to touch on those aspects which best demonstrate the unique nature of our broadcasting system, and illustrate the expectation of the broadcasting services' users - that is, the public of New Zealand.

In the area of new transmission technologies, the Commission looked at cable and direct broadcasting satellite (DBS) developments. In assessing the benefits and costs of cable services, it sought to establish the need for those services and whether lower cost options exist. It concluded that there is no specific need in New Zealand now for cable broadcasting. Some form of cable broadcasting is probably inevitable in the long term, given the reticulation of fibre-optic cabling. It recommended, however, that cabling should be installed first for telecommunications purposes, and should not be entertainment-driven.

The Commission identified alternative methods which are viable in the short term, particularly on the unused UHF band, for providing new services at less cost and with simpler planning, legislation and implementation.

The Royal Commission thought that if New Zealand were to consider a DBS service in the future, it should be used, at least initially, in conjunction with conventional terrestrial networks. For instance, our satellite use might begin as a cheaper system of distributing television signals to existing terrestrial transmitters and repeaters. In any event, there would certainly be a need to preserve conventional transmission for a considerable transition period, especially for those who may not at first be able to afford a home DBS receiver and antenna.

The question of international broadcasting by satellite is one which causes concern to all. We recognise, of course, ew Zealand's geographic situation is different from that of Europe and many other parts of the world. It is inevitable, however, that any future proliferation of broadcast satellites will also affect New Zealand. In the first place, New Zealand viewers might have access to programmes which would not meet standards and codes expected of our own broadcasters. Secondly, by fragmenting audiences, such broadcasts could have a very serious economic impact on New Zealand's domestic television channels

These are not simple issues, and the Royal Commission was not in a position to provide simple answers. It thought that, as a minimum, agreements should be negotiated between governments, to ensure that any organization (public or private) which broadcasts for DBS reception, should be authorised to do so according to government policies and standards applicable in the country of origin. Obviously, this would not entirely solve the problem of international broadcasting, but it would go some way towards the setting of certain minimum standards.

Of equal or perhaps greater importance, is the need to ensure that domestic broadcasting is adequately funded. By far the best means of countering foreign programme intrusion is to produce local programmes providing wide choice and quality, which reflect New Zealand culture and society in an interesting and entertaining way.

While on the topic of satellite systems, it is appropriate to mention recent initiatives taken by the Broadcasting Corporation to explore New Zealand participation in a South Pacific television service.

The Corporation's role would be to make its news reports available to a Pacific news service, to provide access to New Zealand-produced programmes and to arrange facilities and help for any additional programmes required.

To demonstrate this idea, four hours of programming with Polynesian relevance was transmitted by satellite from New Zealand for each of the three days of a recent communications conference at Rarotonga. This constitutes a skeleton scheme for a nightly four-hour programme from New Zealand via INTELSAT V. Each country involved in a common South Pacific broadcasting council would have a video camera team and recorder, and would contribute news and background programmes. These would be packaged in combination with New Zealand and imported material, in a balance determined by the council. It is of course essential to ensure that Pacific countries themselves have an opportunity to develop their own television services and thus protect their own cultures and institutions from any inundation of programmes from other sources.

The Royal Commission endorsed this philosophy, and recommended that the New Zealand Government and the Corporation contribute to a thorough socio-economic investigation of Pacific Island needs and resources in the area of television services. This would include the technical, production and financial implications of a possible television service to South Pacific countries.

At an appropriate time, the Corporation would offer to negotiate agreements for news exchanges relating to Pacific Islanders in New Zealand, relevant developments in New Zealand, and events in participating Pacific countries.

The Commission felt that this would allow New Zealand's co-operation to be focused on assisting the increasingly self-sufficient Pacific Island broadcasting systems.

It should be remembered that Auckland is the largest Polynesian city in the world and, naturally enough, the Commission also looked at New Zealand's radio presence in the South Pacific. The evidence suggested that New Zealand's external broadcasting service should follow through on the generally agreed purposes of our foreign policy towards its nearest neighbours. That means equipping Radio New Zealand with the means to be received reliably and clearly. New Zealand's foreign policy in the South Pacific seeks to help our neighbours through co-operatively planned and executed projects. Initiatives such as the shipping line, or the nuclear testing issue, depend on recognising common interests with and between the Island states. The Royal Commission agreed that radio remains the right medium to assist such a policy. It can speak in the language of the villager as well as that of the technologist or trader, the administrator or tourist.

Radio is the speediest and most comprehensive medium for news, background and analysis. It is flexible, and it can go with its audience into the fields, the store and the workshop, as well as to the kitchen in a way that television cannot.

Compared with the costs of generating or receiving television, shortwave radio is already within the horizons and the means of both senders and listeners. Pacific Islanders will continue to need news of their relations in New Zealand, and their radio systems will continue relaying and quoting from regional and international news services addressing Pacific concerns.

The Commission recommended that the Broadcasting Corporation of New Zealand continue to operate our country's external broadcasting service, from a new high-powered transmission facility which should be established as a matter of priority. Funding of the project would be the repsonsibility of the Minister of Foreign Affairs.

Inevitably, the Royal Commission looked closely at all aspects of the Broadcasting Corporation's operations, and studied the options open to the Government for rebuilding the broadcasting system. It came to the conclusion that there would be no real benefit to New Zealand in a wholesale reconstruction of its broadcasting industry.

Nor did the Commission believe that an open commercial broadcasting environment would satisfy the range of public demands which were made clear throughout the hearings.

The Royal Commission reinforced the need for adequate and certain funding of the Corporation, to enable it to produce, acquire and broadcast a range of good programmes to inform, educate and entertain. This could only be achieved in the foreseeable future by maintaining the mixed funding arrangements now in place. To help achieve this, the Commission proposed that the setting of the license fee be removed from the political arena and placed with an independent tribunal. It envisaged that between five-yearly full-scale reviews, the fee would be indexed to inflation.

The Royal Commission's report contains a great many recommendations relating to programming and administrative matters, the most significant of which would:

--- require that a minimum quota of ten percent New Zealand music be played by all radio stations;

--- introduce a system of awarding points for all television programmes of New Zealand character in content, performance or production, with an overall minimum points requirement for each television channel;

--- increase greatly the number of television programmes which build on and explore Maori culture and interests, with the establishment of a Maori radio network as a priority;

--- put greater emphasis on developing programmes which reflect Pacific Island interests, along with the expansion of access radio opportunities for minority and other ethnic groups;

--- substantially reduce the amount of violence portrayed on New Zealand television, especially during children's viewing hours.

Policy and Regulatory Issues

The Royal Commission on Broadcasting and Related Telecommunications was asked to assess the need for a Department of Communications to provide administrative support and impartial, expert advice in the field of broadcasting and telecommunications services.

The Commission recommended in favour of establishing such a department, with responsibility for co-ordinating telecommunications and broadcasting regulations, and framing international and national communications policy.

In a supplementary study, the Communications Advisory Council reported in some detail on a structure that might meet these requirements.

The Council, set up in 1978 to advise the Minister on telecommunications, suggests that a Communications portfolio be established. As well as taking responsibility for the existing Broadcasting Corporation, a public postal corporation and a public telecom corporation, that Minister would oversee three new policy and regulatory groups.

The Council's report recommends the creation of a Communications Commission to administer telecommunications equipment standards, type approval and frequency management. A Policy and Planning Council is recommended as the ideal organisation to provide the government with the well-researched, independent advice necessary to formulate policies on communications and related information technology issues relevant to the New Zealand environment. The prospect of a more competitive telecommunications industry, giving rise to cases requiring arbitration has also been addressed, and the Council believes that a Communications Tribunal would provide the smoothest arbitration process.

The Council advocated that these new arrangements for regulating the broadcasting and telecommunications industries in New Zealand should be addressed with some urgency in view of the reorganisation of the Post Office into three separate commercial corporations.

It confirms that some government oversight of communications developments should continue, to ensure that the financial objectives of State-Owned Enterprises are not achieved at the expense of social objectives.

No decisions have been made on the final structures needed to cope with these regulatory and policy issues in the long term. We have ensured, however, that the policy and regulatory functions continue to operate outside the commercial telecommunciations environment from the date that the Telecoms Corporation starts operation. Legislation now ensures that competition policy, radio spectrum management and membership of international telecommunications orgranisations will continue for the time being under the Department of Trade and Industry. I will maintain oversight of these areas through the transition to any new structures.

Conclusion

This then is an overview of the telecommunications and broadcasting scenes in our country. Clearly, New Zealand is at an important turning point in both these areas, as the convergence of communications and information technologies becomes a major factor in our forward planning.

The restructuring of the New Zealand Post Office is well in hand, and we will meet the target of 1 April 1987 for the start of operations as three new separate corporations.

A somewhat longer timeframe will be necessary to develop and implement the recommendations of the Royal Commission into Broadcasting and Related Telecommunications, and to put in place new structures for formulating and handling regulatory matters.

Some new legislation will be required, and of course it will take some time to get final agreement on the shape and structure of these new organisations, which we are determined to keep small, lean and efficient.

We now have a set of blueprints which will enable us to chart the further development of policy tailored to a South Pacific island nation of just over three million people. We intend to pursue these objectives with energy and enthusiasm.

Keynote Address

"Consolidating Communication Services in a Multi-National Environment"

Edmond J. Blausten, Director
Pacific and Far East
Electronic Data Systems Communications Corp.

Notes

Consolidating Communication Services
in a
Multi-National Environment

Edmond J. Blausten
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Abstract

Electronic Data Systems, a wholly owned subsidiary of General Motors, has been providing data processing service and system solutions to customers around the world since 1962. Building on the network first established for internal EDS use, then expanded with the GM world network, EDS now provides communications services including voice, data, facsimile, record and video. Presented herein are the steps taken to consolidate systems and facilities, with the resultant design and deployment of a world wide network providing a multitude of services.

EDS AND COMMUNICATIONS

WHERE WE CAME FROM

Electronic Data Systems (EDS) was founded in 1962 by Ross Perot. It was founded on an idea that what the data processing user community needed was a full service organization that would provide not only equipment, but solutions. Solutions that would meet the requirements of the users not only today, but into tomorrow as well. A company that would provide the full range of services, including integrating a wide variety of systems and the actual management of the data processing facility; facilities management.

EDS was highly successful at what it did, growing at an annual growth rate of over 20%. By 1984, EDS employed almost 15,000 people, each furthering the unique spirit and culture of the original founder of EDS. General Motors acquired EDS in 1984 as a wholly owned subsidiary. However, part of the terms of the acquisition was for the preservation of the EDS culture. About 20,000 GM employees transitioned into EDS, and an additional 20,000 have been hired into the company since then.

Today, EDS employs more than 60,000 people world wide, and has sales in excess of $3 billion. More than 2/3rds of this is GM business.

With the establishment of multiple data processing centers in a region, telecommunications between the centers became critical. Communications between these information processing centers (IPC) along with the non-IPC telecommunications requirements has grown rapidly. In 1986, the total communications content in our business will exceed $600 Million; by 1990, we project that it will be in excess of $2 Billion.

COMMUNICATIONS IS CRITICAL

If we look to the future we see that communications will play a key role in the myriad of corporate endeavors that will be undertaken. GM Chairman Roger B. Smith when discussing his views of the future, noted the position of communications as the amalgam that holds the pieces together.

Users are driving communications as the tool for future growth. Communication advances in technology effect a broad spectrum of functions, from CAD/CAM applications through education and engineering, from retail sales and dealers through personnel and financial institutions. Users are taking advantage of the whole range of communication devices available today including data/text, image processing, facsimile as well as traditional (and not so traditional) voice. All types of communication devices and media are being used. These include the newest in fiber technology, microwave, satellite and radio systems. As technology presents itself, the user community is already driving it back to the drawing board for the next step.

INTERNAL SOLUTIONS - TYPICAL APPROACH

Traditionally, within a large corporation a group is formed to address the communication requirement issues. They sit down and develop a mission statement, a list of future activities and an action plan. The mission statement tries to justify why they exist and what their basic functions are to be. Unfortunately, usually the mission statement is content-free; leaving much to the imagination.

Classic statements then appear under the future activities heading. Motherhood such as "improve productivity", "have the competitive edge" and of course clearly indicating that although new moneys will need to be spent, the overall "bottom line impact will be good". Then an action plan just falls out the bottom saying "build our own network"; "establish our own service organization" and surely we need to "replace AT&T and the BOC's".

With these in hand, the "how to.." mode sets in. Two basic approaches tend to surface. The first, occurs when a high-technology oriented individual is in a strong enough position in the organization to jump on his soap box and preach; the "High Priest of Communications". He professes the wonders of SNA, ISDN, X.25, X.400 and more. He talks of the integrated world from Async to PBXs; from SMDRs through VTAM. He preaches the miracles of communications as a save-all solution, to fix anything that is ailing. Alas the balance of the corporate body at best sit back and worry about daily business, if not just fall asleep.

The second approach occurs when a non-technical individual leads the pack, and is unwilling to listen even to the most obviously beneficial new solutions. He has a budget to meet and can't take time or the risk to look at alternatives to the tried and true methods of the past; the "Communication Warrior".

The ideal is to find a happy balance somewhere betwixt these two approaches.

RECOMMENDED COMMUNICATIONS APPROACH

All too often one of the main reasons both the High Priest and Communications Warrior fail, is they attempt to take on the world all at once. To succeed, we have found that you need to start small - define short term objectives that are controllable. As these objectives are met, you gain credibility and support. In addition, you further educate your corporate base, thereby allowing you to integrate newer technology enabling you to deliver the next phase. Thus you start a cycle that grows, each feeding the next; deliver, educate, gain credibility.

To properly manage this, it is key that you have project focus and true control. We must focus on what we CAN do, only few can afford what they WANT to do!

BASIC ROADBLOCKS TO SUCCESS

Even with careful planning and control, there are some emperic roadblocks to success that stand in front of all of us. Any new undertaking (even phased) will required a high level of up front investment. Vendor and supplier lead times are long and are explicitly uncontrollable. Even when you get the system in, a big question hangs over you asking how many people will really use the system? Making it worse is the fact that since users are pushing so hard, new technology is coming out at a break neck pace. How do you keep up? Since you already have a system in place that is in use, how do you assure that what you are putting in is better? Maybe if you wait a day or two something even more advanced will be available that will solve your problems. If you don't wait, maybe what you are putting in will be out of date before you even turn it on!

We in EDS have moved ahead in communications by recognizing and acting on these issues before they come to a head. We have been highly successful in creating, implementing and running what we call EDS*NET.

EDS*NET

A GLOBAL SOLUTION BUILT IN STEPS

EDS*NET is a global network of physical and human resource, dedicated to intelligent information management. The purpose of EDS*NET is to provide the methodology and mechanisms -both human and system- to enable information in any shape or form to be managed and moved from any point to any other point.

Our approach is a building block approach, analyzing each step as a step and building/leaning on those parts that are strong; and reinforcing those that needed it.

EDS APPROACH: BUILD ON BLOCKS

The first step is to build on the existing EDS/GM customer base. Each individual herein represents a captive user. The base includes now over 800,000 employees, more than 20,000 suppliers, 13,000 dealers, a multitude of GMAC/Parts and services offices around the world, credit unions, insurances as well as the hospitals and government activities now underway within the company. This base, a solid one, provides the first step up in building the EDS*NET solution.

The next step is to build on the multitude of networks and services in place, into an integrated system. The networks include more than 200,000 phones, 15 EPSCS, 3 CCSA, 9 ETN, 2500 IMT's, 170,000 data terminals heavy in SNA and SNI, 70+ node X.25 network with access users in over 18,000 locations.

EDS was well familiar with this kind of integration. In the early days of EDS, EDS ordered telecommunications facilities on a need basis. Soon the network looked like a scattering of pickup sticks strewn about the USA. EDS then consolidated the lines into the original EDS NET around the IPC concept, and built a base from that point forward.

The GM network prior to EDS, was however a world wide "broom" that swept across the far reaches.

GM had scores of independently controlled networks that overlapped. GMWDD network spanned the entire US, with loops and fall back lines throughout. A common voice network called "Dial 8" hubbed in 7 locations, serving the 200,000 telephones with a star like network. The financing part of GM had similar networks, as did Chevrolet, GMAD, and the GM interstate Data requirements. Overlaying diagrams of these on a map resulted in a black & white drawing going full color!

With the acquisition of EDS, the resultant overlap was clearly opportunistic. In the United States, EDS expanded the EDS Integrated Network concept. The EDS*NET architecture is comprised of 3 levels of switching systems that are fully integrated. Local level 3 switches provide basic access and local switching services with connectivity into regional level 2 switches. These level 2 switches (some providing local service too) enable a traditional star-like network environment to be controlled at the regional level. These level 2's then connect into high-speed tandem switches called level 1. These level 1 switches are integrated and cross connected providing true tandem switching.

BASE IN PLACE? START BUILDING!

Having gained basic credibility with the initial integration, the next step is to further the network by developing a true digital infrastructure. To do this, a strong capital infusion was necessary, to enable the deployment on further systems as well as new media.

The work now underway includes the expansion to over 300,000 stations served by more than 500 switches. Data terminals have now grown in population to over 250,000 with a multiplicity of protocols abounding. More than 30,000 trunks are now installed including the use of microwave and satellites.

Realizing that concentration of users within a region begets economies of scale that can be best realized with private systems, EDS has installed our privately owned and operated microwave system in the Southeast Michigan area. More than 2,000,000 circuit miles covered by over 128 digital microwave miles have been installed. Initially started as a voice service network, now more than 70% of the traffic being carried is data for engineering!

We have two main campus areas (one in Michigan and one in Texas) that have been wired with Fiber Optics. Our GM Technical Center has over 15 buildings interconnected by fiber, offering very high speed transmission paths. Voice and data are zipped around the campus and gateways are provided out to the full world network. The campus in Texas is at our EDS Corporate Headquarters where both management and data processing services take place. Fully interconnecting the information processing centers enables centralized control and minimal duplicate staffing in different buildings.

THE RESULT: A FULLY DIGITAL INTEGRATED NETWORK

The resultant network services not only voice, but data and video as well. To complete the picture, a further deployment of Network Management systems, internal control/inventory systems as well as gateways to public service providers must be done.

The EDS Network Management System (NMS) is controlled out of two diversely located centers; The Auburn Hills NMC and The Plano NMC. These NMCs are connected to the basic transmission system, the voice specific components, as well as the data components and video service systems. Thus the NMCs are able to control the entire environment. Supporting the NMC, giving rise to the NMS, are a multitude of support systems. These support systems include a service order system to track and log orders, a trouble reporting system, a complete inventory system (from instrument to plug), traffic data collection and analysis system, as well as a financial control system.

These support systems are fully interconnected to enable customer service, field service, network administration and engineering to all access the same information at the same time. This provides an integrated solution to the network control and management problems faced day to day having over 600 computers establishing more than 30,000 interconnections between them and the greater than 500,000 access devices being served.

TIE IN THE ENTIRE NETWORK

With the successful integration and operation of the network, another level of credibility has been added. Its time to expand network with further infusion of capital, tieing more existing pieces of the overall puzzle together.

EDS*NET in Europe has grown with the same basic steps as EDS*NET in the USA. Pre GM, the EDS SNA network covered more than 7 countries, hubbed in England and Germany. GM had networks in Europe that hubbed in England, Belgium and Spain. Coming off these hubs were lines to over 40 locations in Europe for data service. Major data centers included England, Belgium and Germany. Within Germany GM has complete operations of the GM OPEL group demanding services. The voice network for GM was almost a direct overlay of the data network, with some line sharing already taking place.

EDS*NET has been designed in Europe in three phases. The third phase is scheduled for completion later this year. It will provide for tandem voice switching over digital pipes that carry integrated voice, SNA, X.25 and occasionally video too. The consolidated network in Europe covers the gamut from A to Z, from Left to Right (from Antwerp to Zaragoza and from London to Russelsheim). Major digital backbones will tie these points together, with 56kb and slower lines interconnecting the balance of the locations.

The entire European network is already interconnected to the USA using a private satellite service. Installed at our Auburn Hills facility is an E-3 earth station that communicates with a satellite connecting us across the atlantic ocean into the digital backbone in Europe. Two different down-link are used in Europe to assure redundancy and fail safe operation.

Two T-1 bearers are currently in use, with digital multiplexing equipment at the T-1 level enabling routing and load sharing. The T-1s are parsed to provide 46 voice circuits - more than the original GM and EDS European networks combined. In addition to the voice circuits, over 128kb of data is handled (supporting both SNA and X.25) as well as a 768kb video partition. Even with all of that, we have an additional 612kb as of yet unassigned!

The result has been a visible increase of 300% capacity at a 20% cost reduction!

GROW THE NETWORK

Now that all of the base pieces of the puzzle are linked together and operating, it is time to grow the network into far reaching areas around the world; building new services, in new locations, for a new and ever expanding customer base.

The Pacific & Far East is seen as a perfect arena to grow EDS*NET. An existing base of GM/EDS activity exists in 6 countries, including an entire automotive operation (GM Holden Australia). The existing technological communication base includes AVD and SVD circuits, as well as teletype channels.

Based upon the business forecasts in the region a Pacific Area Regional Network has been designed and is now in it early stages of deployment. The new regional network will tie the existing presence to the overall EDS*NET with satellite links, enabling interactive communications to be switched world over.

The new expansion into the Pacific region will connect not only the 6 current countries together, but also an additional 5 countries in which marketing efforts are now underway.

DON'T FORGET THE BASICS OF THE PLAN

With a plan the size that we have been talking about, it is quite easy to forget the overall goals of providing information management to EDS, GM and all of our customers. The ability to do this rests upon proper integration of voice data and video services, while keeping the network as up-to-date as possible without falling "off" the leading edge of technology.

The user base for our network is quite broad. It encompasses GM, EDS, Hughes, all of our respective customers, suppliers and dealers. They all have needs for connectivity, but the details vary. Some have host computers, others wide area networks. Some are factory based, while others office; Some use terminals directly connected via modems while yet others wish to use LANs. A wide variety of media exist to communicate over, and integration means serving the existing base. The existing base includes satellite, twisted pair, coax, fiber optics and even micro waves. Everyone is looking for increased performance, but each has there own idea on what better performance means; in some cases lower cost, to others higher security, still more expect better quality in signal yet some believe performance to mean response time!

All of these can only be tied together world wide by establishing a set base or building block that is defined by one or more of the standards that have arisen. Standards, both those developed by standards bodies and those "defacto" standards based on use, do provide the glue to service the users in a wide variety of media under the guidelines of diverse connectivity with a network with demonstrable increased performance. Standards provide the basis, that first all so important building block.

EDS build itself in data processing by defining a standard building block - the IPC. Each IPC looks alike, and can be built from ground up within six months. This approach has now been defined for communications in what is called a Regional Node.

REGIONAL NODE: THE COMMUNICATION BUILDING BLOCK

The EDS Communications International Regional Node is a collection of services that revolve around the standards and provide full integration of voice, data and video within a common building block.

The first module in a Regional Node is the voice exchange. As the existing customer base has an installed base of PABX systems, the voice component initially acts as data gatherer, collecting statistics and validating bills from the local PTT.

As traffic is identified specific to the private network, a dedicated high speed digital lease is justified. The regional node will support up to 16 T-1 facilities on the backbone side. The T-1 interface is done through a digital parsing unit that supports analog voice inputs, digitizing them at rates from 64kb (PCM), through 32kb (ADPCM) all the way down to 19.2kb (CVSD) and even lower if need be. Connecting in the private T-1 channel to the voice exchange provides for 24 or more voice channels specific to the private network in addition to the remaining local telephone company connectivity. Thus with a given level of traffic destined for the voice private network being sufficient to justify a private T-1, over half the T-1 can then be derived for non-voice applications!

Dedicated host services including video applications at speeds of up to 768kb can be scheduled on the remaining part of the T-1 based upon the actual demand for such dedicated service. Rather than offer just voice and dedicated service, the Regional Node continues further in standardizing and offering a uniform service.

A high speed packet methodology data switching exchange is interconnected within the Regional Node. The packet exchange is connected to the voice module through a dedicated Service PAD. The PAD provides X.3, X.28 and X.29 connectivity and access from the voice exchange (on a contention mode basis) to the X.25 network services. The primary aggregate from the packet exchange goes out over the digital parsed T-1 to kindred systems world wide. Finally additional X.25 lines leave the exchange as fall back by being connected to the local public PSPDN.

Subscribers on the voice side now have analog access to the packet network within the node by simply dialing an extension number. If traffic warrants it, dedicated PADs with specific protocols (such as 8A1 or SDLC or others) can be deployed at the customer site and then interconnected with the Regional Node utilizing X.25. Full connectivity in cross-protocol application is assured by the use of standardized session interpretation used throughout the EDS*NET system.

Having provided voice, video and data connectivity, the next requirement (and hence next module) for the Regional Node is in Messaging. The EDS Message Exchange is a store and forward technology system that interconnects to the Service PAD for asynchronous access, and through the Packet Exchange for other protocols. Utilizing the X.400 series of recommendations and a Class IV transport mechanism over the X.25 backbone, the Message Exchange can broadcast and interconnect with a multitude of remote systems world wide. Users access the system locally by dial up through the voice exchange or by dedicated lines to PADs or into the packet exchange. Full connectivity and support is thereby provided.

The next technology required in the Regional Node is Facsimile. The EDS FAX Exchange is then interconnected in the Node. The system connects to the voice exchange offering groups II and III access by dial up. The system is store and forward enabling mailing lists, mail boxes and broad cast mode as well. The aggregate output to other nodes is done by the interconnection to the packet exchange using X.25. All stored messages that are transmitted out to other nodes is converted to G IV specification for transmission over X.25. In bound are converted back to G II and G III depending upon the destination requirement.

The final service added to the node is digitized encrypted voice. Most in-country circuits are actual cable tie-lines, so the concern for security lies in the international satellite portion. Encrypted voice, following the US government recommended DES algorithm, provides for security even over the satellite environment.

With all of these service modules in place, the Regional Node is complete. As new customers are identified, only voice tie-lines and a single data line need be added. No new switching systems, no new exchanges and no education of operators is required. Just plug in the user and turn it on!

Using this cookie cutter approach, multiple nodes will be deployed and facilities management will begin in the communications arena.

The first Regional Node is being deployed in Tokyo Japan early this year. It's connective counterpart is being deployed in the USA, being interconnected with one of the first private T-1 bearers across the Pacific Ocean.

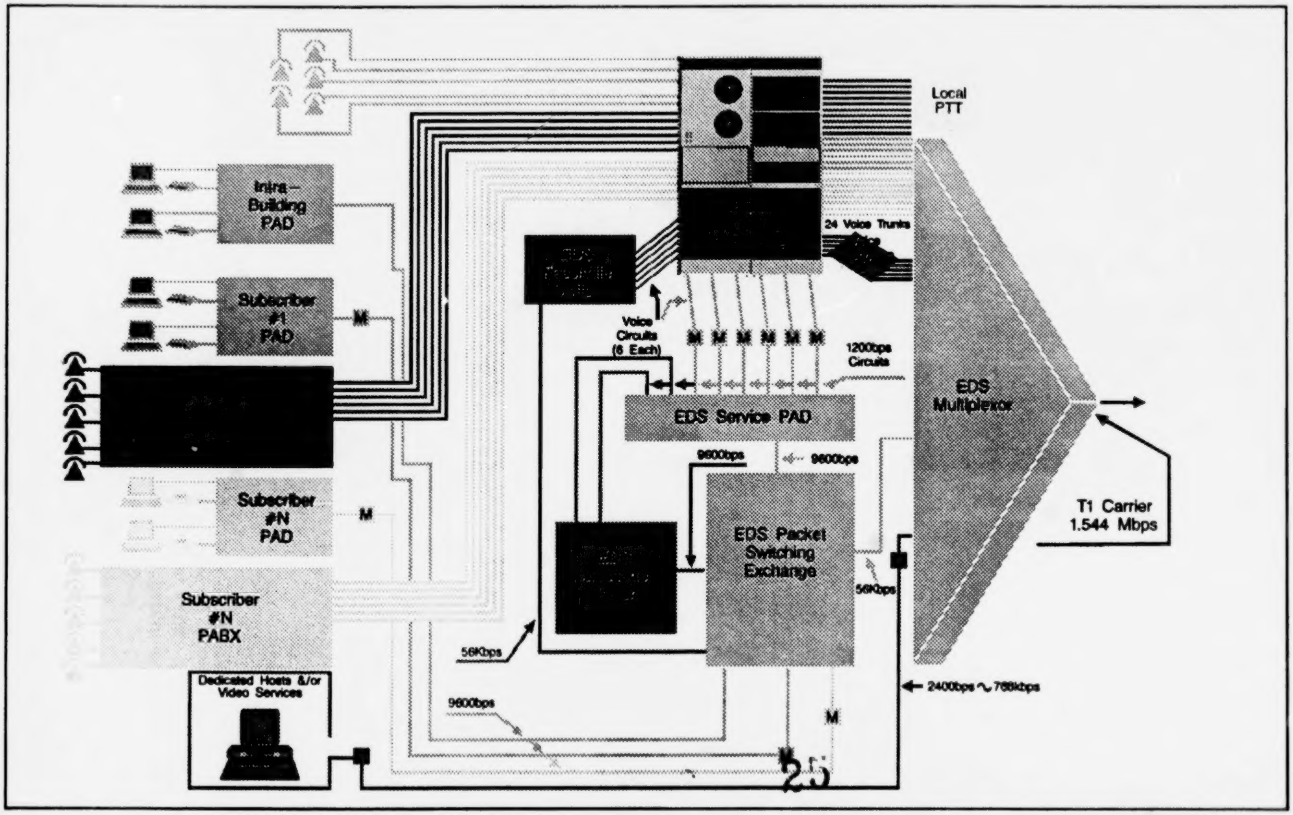
The next Regional Node will be in Singapore, with others following in the United Kingdom, Europe and Australia. Connecting access lines to the nodes will enable neighbor countries to interconnect to the full spectrum of services world wide.

CAN WE BUILD ONE FOR YOU?

Just as EDS did with the data processing industry, we are now approaching the communications community with full facilities management. Having built our Regional Node, now is the time to build more and deploy them throughout the world. Imitation may be the highest form of flattery, but replication is the key to our success.

Our licenses in various countries of the world enable us to layer our network to assure privacy in a true managed environment for a multitude of customers. Full service deployment for GM and all EDS customers enable us to reach economic levels of scale that are unparalleled. Working with the PTT's we believe we are opening up a new age in communications; World-wide, Multi-national, Turnkey Communication Facilities Managed Networks. Care to take it for a spin?

EDS Communications International -- Regional Node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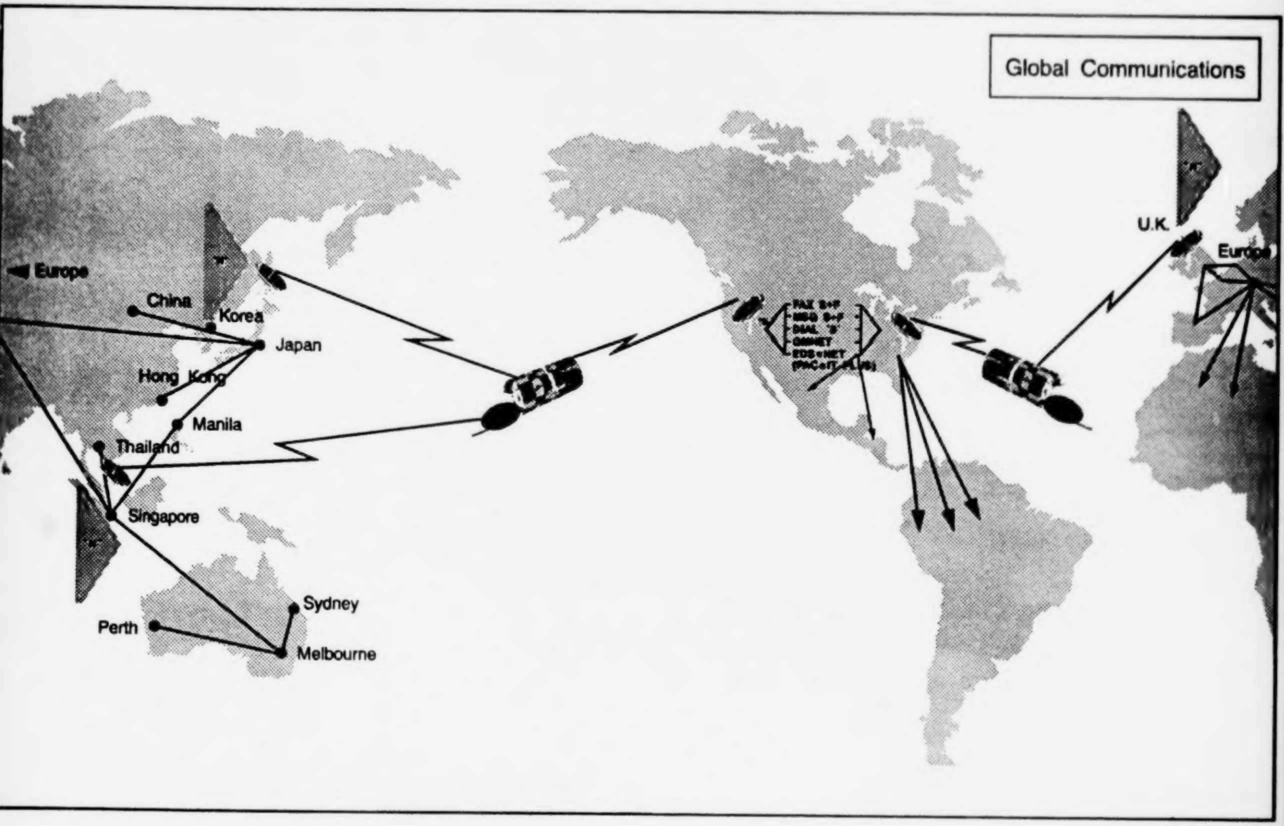
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Keynote Address

"Telecommunications and the Emerging Global Corporation"

R. W. Sturm, Director of International Marketing
AT&T Communications

Notes

Keynote Address

"International Users: Their Place in Planning"

Peter Smith, Vice President
International Telecommunications Users Group

Notes

International Users: Their Place in Planning

Mr. Peter Smith
Reuters Limited, LONDON, England

Abstract

The International Telecommunications Users Group. Its aims, membership and activities. What users would like to see in the telecommunications marketplace. INTUG's views on two major issues of the telecommunications supply side: Private Networks and ISDN.

A few words of introduction. The International Telecommunications Users Group (INTUG) was formed in 1974.

It exists to promote user interests at regional and international level and to ensure that the voice of the user is clearly heard when policy issues are discussed.

From its formation in Brussels it has sought to establish its presence wherever telecommunications developments are evolving holding strongly to its initial objectives.

INTUG is non profit making with three classes of membership. Full members are drawn from national and international associations throughout the world.

They range from the vast International Telecommunications Association ICA of the United States to the modest Austrian Data Users Association ADV.

The two international organisations are the European Association of Information Services EUSIDIC and the International Videotex Industry Association IVIA. EUSIDIC itself has links with some 1800 organisations in 27 countries.

Within the Pacific region members include the Federation of Japanese Communications Association FJCA, the Australian Telecommunications Users Group ATUG and the Hong Kong Telecommunications Users Association HKTUA.

INTUG's second category of membership is Associate. Associates are companies with an interest as users in international telecommunications. They represent major service and manufacturing industries including banking, information, broking, insurance, travel, airlines, computing and oil.

They are companies not surprisingly which spend millions of dollars on telecommunications and depend on national and international telecommunications for their competitive commercial efficiency.

Thirdly INTUG also invites individuals as members.

Two landmarks in INTUG'S brief history illustrate the gains made to incorporate user participation in policy making in the top telecommunications regulatory bodies.

In 1979 INTUG was accepted by the CCITT as a member with observer status and has been participating in CCITT activities without a break since that date.

Secondly in 1985 the International Telecommunications Union ITU presented its first international conference dedicated to the user and organised in co-operation with INTUG called USERCOM 85.

This is to be followed with a second USERCOM in March and affirms the unequivocal attitude adopted by the ITU that users' voices must be heard.

So now that we are being heard what do we have to say. A look at the basic principles which the business user considers should be addressed within the telecommunications industry.

(i) Users should have the freedom to choose among competitive suppliers for the provision, installation and maintenance of telecommunications equipment and services.

(ii) The international marketing of telecommunications equipment should be open to all on a fair and competitive basis without trade barriers.

(iii) Innovation, development and application of new products should be encouraged.

(iv) The formulation of and adherence to standards should be supported by users, suppliers and governments.

(v) National and international legal and regulatory environments should be kept under active review so that they can be adapted to technological developments.

(vi) Action is necessary to promote an adequate supply of suitably qualified staff to serve the information technology and telecommunications industry and its users.

(vii) Barriers to the free flow of information should be avoided.

(viii) Users should be free in principle to use transmission services for the passage of information without reference to whether it is text, image or voice.

(ix) PTTs should give priority to improving the quality of public networks.

(x) Public service tariffs should be fair to customer and supplier and where possible related to costs.

INTUG believes that if these objectives were fulfilled, an infrastructure would be created within which businesses could take best advantage of the advances in information technology to the benefit of all.

In the meantime while these universal aspirations are pursued the telecommunications business user must operate with the conflicts as well as the opportunities of regulatory, technical and tariffing changes.

INTUG's views on two of the issues under discussion at PTC 87 follow.

Private Networks

The development of private networks based on private leased circuits is recognised as a continuing growth sector of the telecommunications business.

Private networking has been a distinctive feature of the expansion of data communications nationally and internationally and has provided a highly satisfactory rate of return to the PTTs on their investments.

The attractions for the heavy telecommunications user of private circuits are many: They are cost effective, flexible in design, secure, transparent, manageable and adaptable for innovation.

In the words of one former PTT, now a PTO, a private circuit is "convenient ... is under your control and available for your use only, 24 hours a day. Because it's yours, there's no delay while dialling or making a connection.

"It's secure and private. The circuit is for your personal use only so your messages enjoy a high degree of privacy.

"It has a duplex facility, which means you can send and receive simultaneously."

But it is a matter of concern to users that the long-term viability of the service continues to be questioned by many telecommunications agencies.

Because of the firm belief on the part of some PTTs that a standardised public data network will ultimately be a more expedient and beneficial solution for the user it is the concern of the user that this may become a self-fulfilling prophecy because of the PTTs dominant position.

There is ample evidence that with the introduction of public data networks PTTs will try to limit the choice of the user, by denying the leased circuit option or tariffing it unfairly.

The promotion of a usage sensitive method of charging by some administrations is a disturbing trend for the users who have invested heavily in private networking and who therefore regard volume tariffing as a serious potential breach of faith by the PTTs.

Users are adamant that much of the beneficial development in data communications has been due to the existence of the private leased circuit facility and any attenpt to force migration from it to public networks would be regarded as an abuse of the dominant position of the telecommunications agencies.

Integrated Services Digital Network

The attitudes of users towards ISDN so far can be best described as ranging from concern to cautious optimism.

The optimism is due to the rich promise which digital technology presents and from which users expect to benefit.

The concern stems from interrelated doubts regarding the costs of development, the transitional arrangements which will be necessary and in particular the tariff principles which will be applied.

ISDN is an evolutionary development and it is far from clear how long the emergence of a wholly digital transmission and switching network for all types of traffic including voice, data, text and image will take.

Most telecommunication agency forecasts of the timescale for introducing the ISDN nationally range from 1987 to 2020.

A telecommunications manager concerned with a business plan for the next five years will have difficulty in seeing how migration of a large network can be carried out in the face of such uncertainties.

While the technical standards are being debated and considerable progress has been made at the CCITT in this area the development of ISDN has been seen so far as a strictly PTT affair.

To maximise the benefits that may be gained from the vast investments which will be sunk into these national enterprises by PTTs there is a need for further discussion.

Users should be consulted on their requirements as perceived by the PTTs from the planned networks and on their expectations on price and performance.

Standardisation that allows network interconnection and simple attachments on a worldwide basis is essential.

A paper setting out the business users' views of ISDN is published by the International Chamber of Commerce, in which users' concern about freedom of choice among services, interfaces, equipment and future options; about the distinction between monopoly and competitive services; about transitional arrangements, and needless to say, about costs, are addressed in more detail. INTUG supports the ICC's conclusions.

Monday, January 19

Plenary

Large Business and Industrial Users

"Users' Point of View"

Harold Heinze, President
ARCO Alaska

Notes

"Use of Virtual Private Networks to Satisfy Large Users' Needs"

M. Iwama, Executive Director,
Switching Systems Engineering
AT&T Bell Laboratories

Notes

Use of Virtual Private Networks to Satisfy Large Users Needs

M. Iwama

AT&T Bell Laboratories
Holmdel, New Jersey, USA

ABSTRACT

The evolution of stored program control switching and common channel signaling has facilitated the development of several new public network based services--e.g., 800 Service, Automatic Calling Card Service, etc. As an application of these capabilities to private network service, Virtual Private Network (VPN) has emerged as a state-of-the-art alternative to meet private customers' networking needs. VPN service--a software-based virtual network service--simulates a private network using public network switching and transmission facilities. This paper describes the motivation and evolution of VPNs as well as their typical features and capabilities. Due to the author's familiarity with the products, more detailed examples of specific implementation on AT&T products are presented to help the reader gain insight into the applications of the VPN concept.

1. *BUSINESS AND INSTITUTIONAL CUSTOMER NEEDS*

Business customers with multiple locations frequently need an efficient means of network communications. Currently, many of these businesses use private networks, typically consisting of PABX/Centrex sites interconnected by dedicated transmission facilities. They usually purchase or lease the switching and transmission equipment at a fixed cost.

By using private networks, these customers have benefited in several ways. First, private networks provide a cost effective means of transmitting information. Second, they provide greater control over telecommunications by allowing customers to restrict calling privileges and determine least cost routing schemes. Finally, such features as uniform numbering plans further enhance the functionality of private networks and provide customers with capabilities that would otherwise not be available.

2. *HISTORICAL PERSPECTIVE ON THE EVOLUTION OF PRIVATE NETWORK*

The number of private network services proliferated manyfold in the last decade--and the types of services became almost equally diverse due to a) advances in technology and b) increasingly diverse customer demands. As illustrated in Figure 1, Tie-line service can be considered as the first, simplest form of private network service. The network essentially comprises two PBX/Centrex locations interconnected by dedicated transmission facilities. As a natural extension of tie-line service, Tandem Tie-Line Service emerged, accommodating those with more than two locations with tandem offices. To illustrate its operation, take a network consisting of PBXs A, B, and C, where PBX B functions as a tandem for PBXs A and C. To originate a call from A to C, a caller first dials an access code to reach PBX B. Upon receiving a dial tone from PBX B, the caller then dials another access code to instruct PBX B to establish a path to PBX C; namely, a different access code is required to reach the same station depending on the originating location. To alleviate this problem of non-uniform numbering plans, Common-Control Switching Arrangement (CCSA) was introduced in late 60s as the first private network service offering uniform dialing over dedicated private facilities. Further exemplifying advancement in the implementation of private networks, a more sophisticated version of private network service called Enhanced Private Switched Communication Service (EPSCS) was introduced in 1978. Some of the unique EPSCS features are 4-wire transmission (to improve transmission quality) within the private network and a Customer Network Control Center, which customers can use to control some network operations and to obtain private network usage/status information. Subsequently, Electronic Tandem Network (ETN) was introduced in 1979 with many EPSCS-like features. Overall, ETN offers customers less sophisticated customer control capabilities at lower cost. Likewise, in the area of data communications, the number of service offerings--all based on dedicated facilities--have been increasing; just to list a few, there are DATAPHONE digital service (offering highly reliable data communications over point-to-point or multipoint lines at data rates of 2.4, 4.8, 9.6 and 56 kbps), DATAPHONE Select-a-station (primarily for remote telemetry application), ... etc.

However, these private networks suffer from a number of shortcomings. First, OA&M responsibilities typically require considerable customer resources. In addition, the cost of providing a Public Switched Network (PSN)-equivalent grade of service may be prohibitive.

Moreover, businesses with geographically dispersed locations often find including remote locations in their private networks extremely expensive due to long access lines. Finally, many hardware-based networks cannot evolve gracefully with changing technology and varying traffic demands. Thus, many customers are looking for alternatives to satisfy their corporate telecommunications needs.

3. *VPN DEFINITION AND CONCEPTS*

To alleviate/eliminate many of these problems inherent in a dedicated private network configuration, several interexchange carriers (AT&T, DAMA Telecommunications, ISACOMM, MCI, Satellite Business Systems, Western Union, ... etc.) have announced their plans to offer a service based on the Virtual Private Network (VPN) concept. As the word "virtual" implies, in VPN there are no transmission facilities or switching equipment dedicated to a particular customer. When a customer (loop- or PBX-based) originates a voice or data call, a communication path is established only if there is an idle public circuit to the terminating exchange. As such, a circuit is dynamically allocated to a customer only for the duration of a call. Naturally, since service requests are independent among different customers, be they VPN- or POTS-type, there exist the "economies of scale" cost savings from sharing the public network.

Since a VPN is simulated by software in a public network, the network architecture for VPN is fundamentally the same as that for a public network. It consists of a number of public exchanges equipped with special intelligence to recognize and process VPN calls. However, due to the nature of some of the VPN routing features, separate *centralized* databases--specialized to handle VPN calls--are often deployed in a common channel signaling (CCS) environment. Deploying centralized databases will enormously simplify the OA&M process; e.g., to add a new node to the network, only the centralized database(s) would need to be updated, as opposed to updating all the switches involved. The call flow for an on-net[1] call in this case (commonly referred to as a centralized architecture) would be as follows (see Figure 2):[2]

- A VPN subscriber dials an on-net number.
- Upon recognizing this as a call requiring special handling, the VPN switch formulates and then sends a query to the database for translation and other call processing information.
- After executing necessary call processing routines, the database sends proper instructions, containing a routing number and billing information, back to the VPN switch.
- The VPN switch routes the call to an appropriate station according to the specified routing number and records necessary call logging data.

Functionally, there are two kinds of VPN access arrangement: standard and special. Standard access is a switched connection from the customer's premises through a local exchange to a VPN switching node; the local exchange, functioning as a transit switch, simply routes the call to a VPN switching node via a group of specially designated VPN circuits (often shared among multiple customers). Special access refers to a direct connection from the customer's premises to a VPN switching node. For each customer location, the choice between the two is based on such factors as traffic volume and distance to the nearest VPN switching node. In general, standard access is appropriate for a remote location far from any VPN switching node. As the Integrated Services Digital Network (ISDN) concept further materializes, an integrated access arrangement is also expected to be available (implemented most likely in the special access mode). By sending a proper message indicating service type (e.g., VPN, Packetized Data Communication, ... etc.) at the beginning of a session to the host exchange, a caller with integrated access can use the same access channel for different service applications at different times.

4. *TYPICAL FEATURES OF A VPN*

Most VPNs include a fairly similar set of base features with variations due to a particular implementation or specific customer needs. A typical set of key VPN features is described below with emphasis on the functional capabilities provided by the feature.

Customer Definable Numbering Plan VPNs can support differing numbering translations based on path of entry to the network. This allows customers to maintain existing private network numbering plans or to tailor their VPN numbering plans to meet specific needs. For example, many domestic private networks use 7-digit numbering plans. However, with extremely large networks (e.g. thousands of locations), a 10-digit numbering plan may be required. If Centrex locations are incorporated in a small network, an abbreviated, 5-digit plan may be appropriate. Certain customers may even require an open, variable numbering plan. All of these are potentially available through a VPN service.

Closed User Group Capabilities To provide customers with direct control over the usage of VPN facilities, closed user group capabilities are supported (see Figure 3). This capability, implemented in a variety of ways, is aimed at providing both a security and a cost control function. The general form of the capability is mapping groups of originations with groups of

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[1] On-net here means *within the same VPN network*, as opposed to say from PSTN to a VPN.

[2] In the absence of databases (commonly referred to as a distributed architecture), the call process very much resembles that of a POTS call, except that it may involve a routine pertaining to a specific set of VPN features assigned to the customer.

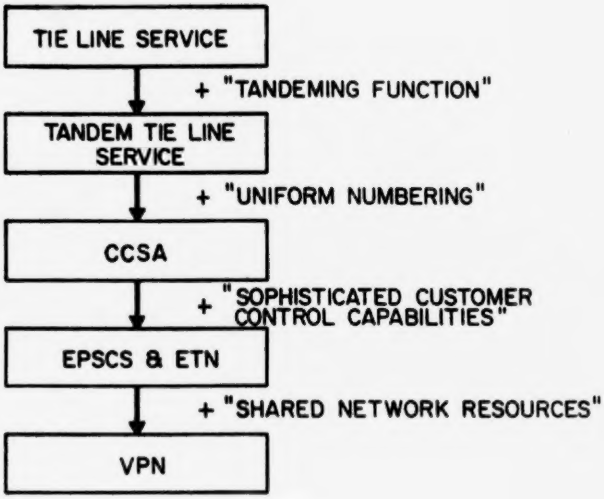

TIE LINE SERVICE
+ "TANDEMING FUNCTION"
TANDEM TIE LINE SERVICE
+ "UNIFORM NUMBERING"
CCSA
+ "SOPHISTICATED CUSTOMER CONTROL CAPABILITIES"
EPSCS & ETN
+ "SHARED NETWORK RESOURCES"
VPN

FIGURE 1: SIMPLIFIED PERSPECTIVE ON THE EVOLUTION OF PRIVATE NETWORK SERVICE

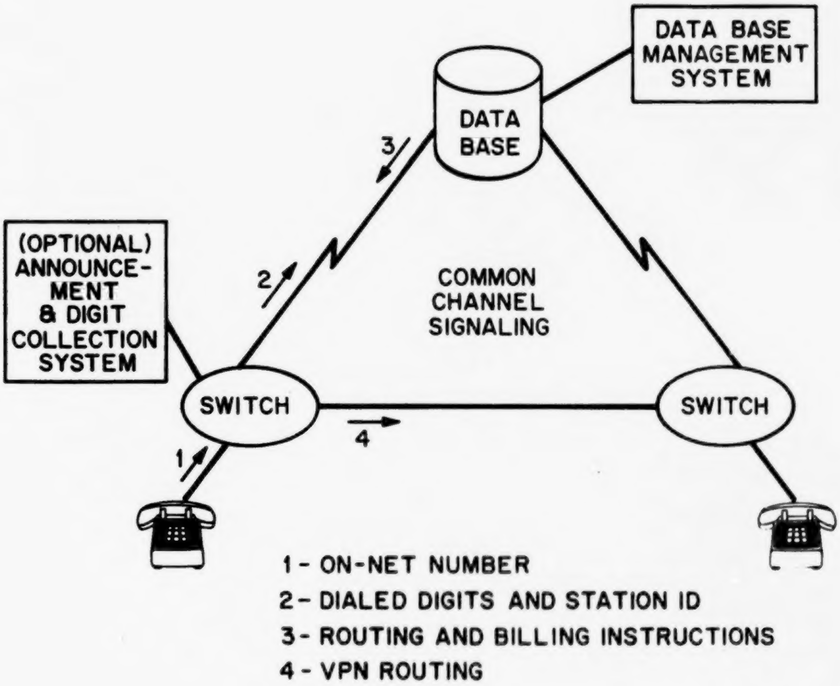
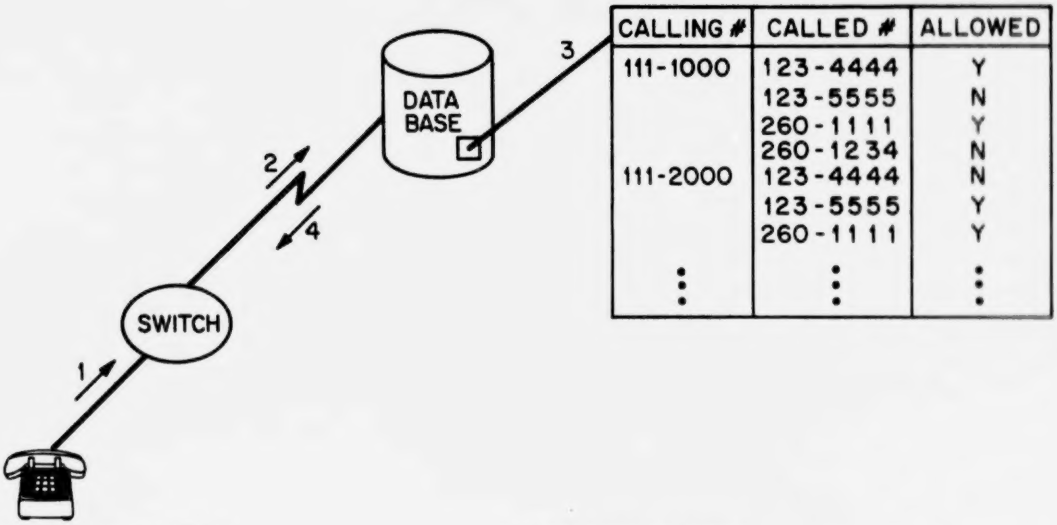

DATA BASE MANAGEMENT SYSTEM
DATA BASE
3
(OPTIONAL) ANNOUNCEMENT & DIGIT COLLECTION SYSTEM
2
COMMON CHANNEL SIGNALING
SWITCH
SWITCH
4
1
1 - ON-NET NUMBER
2 - DIALED DIGITS AND STATION ID
3 - ROUTING AND BILLING INSTRUCTIONS
4 - VPN ROUTING

FIGURE 2: VPN CALL FLOW

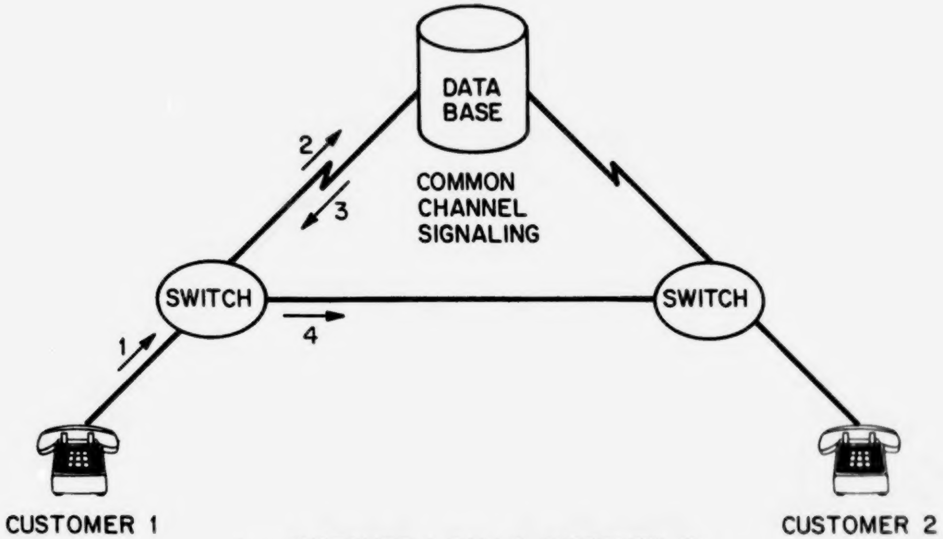

DATA BASE
SWITCH
1
2
3
4

CALLING #	CALLED #	ALLOWED
111-1000	123-4444	Y
	123-5555	N
	260-1111	Y
	260-1234	N
111-2000	123-4444	N
	123-5555	Y
	260-1111	Y
⋮	⋮	⋮

CALLING # 111-1000
CALLED # 123-4444

1– CALLED NUMBER
2– CALLED NUMBER + STATION ID
3– ALLOWED
4– ROUTING OR BLOCKING INSTRUCTION

FIGURE 3: CLOSED USER GROUP EXAMPLE


DATA BASE
COMMON CHANNEL SIGNALING
SWITCH
SWITCH
1
2
3
4
CUSTOMER 1
CUSTOMER 2

1 – CUSTOMER 1 CALLS CUSTOMER 2
2 – DIALED DIGITS AND STATION ID
3 – ROUTING AND BILLING INSTRUCTIONS
4 – VPN ROUTING

FIGURE 4: INTER-VPN CALLING

destinations. For example, access to certain computer stations may be authorized to only a small set of VPN callers. To control costs, a VPN may provide the capability to limit access to off-net locations during non-working hours.

Inter-VPN Calling A fundamental capability of a VPN service is the ability of callers to reach other stations within the same VPN. A slight variation of that capability is the ability to place calls to stations within a different VPN (see Figure 4). This feature is intended to provide inter-VPN calls any additional functionality available to intra-VPN calls (e.g., abbreviated dialing). In addition, any inherent economic benefits of VPN will apply to these calls. This feature is applicable to companies with frequent communications such as parent/subsidiaries.

Break-In and Break-Out Calling Access to and from the public telephone network is of interest to many VPN customers. Break-out calling refers to the capability of a VPN caller to access POTS stations via VPN access facilities. This feature, as illustrated in Figure 5, provides the benefit of integrating two types of calls as well as providing callers with VPN functionality on calls destined for non-VPN destinations.

Break-in calling refers to the capability of callers from non-VPN stations to access VPN facilities, possibly toll-free. This allows callers to reach VPN stations from remote locations and, in the case of toll-free access, the capability of directly allocating costs of business calls to the service.

Customer Control and Administration With a software-based service, customer control is more readily provided. In addition, with a centralized database implementation, centralized control is facilitated. Such benefits as real-time updates, reductions in staffing and equipment, and ease of combining network wide data and reports are realized. Section 6.1 describes a centralized virtual network service currently offered by AT&T-Communications and the control and administration functions that are provided.

Authorization Codes As a means of providing calling privileges and additional security, VPNs may provide the capability to prompt callers for authorization codes. For example, to distinguish callers and provide additional security, access to a particular computer number may require that a caller enter an authorization code.

5. *USER BENEFITS*

There are several key parameters affecting the economic trade-offs between dedicated lines and VPN, including 1) community of interest (degree of traffic dispersion), 2) geographic dispersion (distance between customer locations), 3) on-net traffic volume, 4) tariffs for private lines, 5) tariffs for virtual lines, ... etc. To gain some insight into the economics of VPN, consider a customer with a need to interconnect two PBXs at different locations. To avoid complication, let us further assume that the on-net busy hour traffic and the distance between the two locations are fixed at 7 erlangs and 30 kilometers, respectively. From Erlang B tables (one percent blocking), 14 circuits are required to handle this traffic if dedicated lines are to be deployed. To determine the equivalent circuit requirement for VPN, let us assume that the background public traffic volume is 84 erlangs, which amounts to 100 circuits. Since the circuit demands are independent between the private and the public network customers, the combined load of 91 erlangs (84 plus 7) would require 108 circuits--just 8 more than were required to carry the public traffic; namely, the virtual case requires 6 circuits less than the dedicated case. Figure 6 illustrates the percentage of circuit savings from using VPN for this configuration; namely, (dedicated lines - virtual lines) / dedicated lines. Further depicted in Figure 6 are the impacts of increasing private network traffic and background public traffic. In summary, the percentage of circuit savings is inversely proportional to the private traffic volume and is proportional to the background traffic volume.

Besides circuit savings, the following additional benefits help VPN attract business customers of practically any size--large or small.

- VPN networks are essentially controlled by software. Thus, each customer's VPN configuration can easily be modified to reflect his/her varying traffic and service requirements over time. This is done simply via a regular CRT terminal interface to a database or a switch that contains call processing logic. Unlike in many prevailing hardware-based private networks, numerous support tasks, such as network reconfiguration and service provisioning, become very simple with VPN.

- The public network often has higher performance standards than dedicated private networks in terms of reliability, blocking, availability of spare parts, ... etc. Since a VPN network is an integrated entity within the public network, the private network customer can receive the same grade of service as the public network customers.

- A customer in a dedicated network has to purchase/lease (i.e, paying for the exclusive right to use) a certain number of circuits. Since virtual lines are shared among multiple customers and services, there is a potential for a usage-sensitive tariff with VPN. As a result, VPN provides an economical means for accommodating customers of practically all traffic levels.

- The use of the public switching/transmission network obviates the need to maintain a separate private OA&M support system. Furthermore, any new state-of-the-art technologies that are introduced in the public network arena--such as ISDN, optical fiber, Universal Information Services (UIS), ... etc.--would be more readily available to VPN customers. In short, to a customer VPN means receiving private network service based on the latest technology.

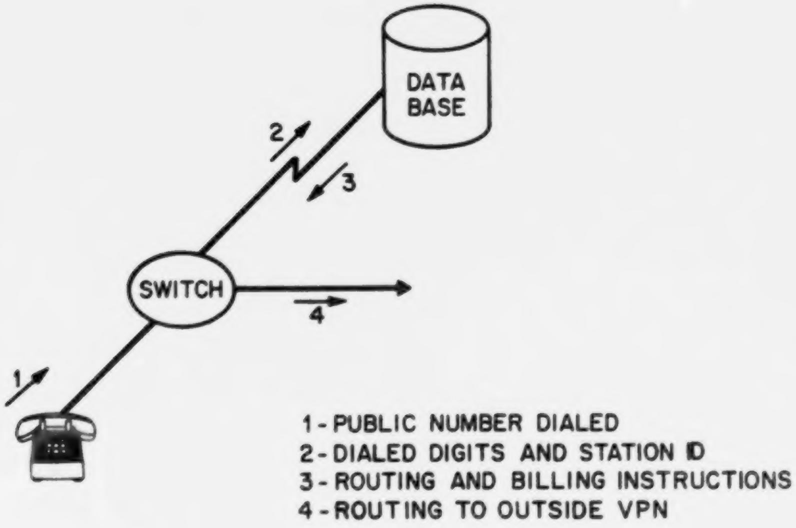

DATA BASE
SWITCH
1
2
3
4
1 - PUBLIC NUMBER DIALED
2 - DIALED DIGITS AND STATION ID
3 - ROUTING AND BILLING INSTRUCTIONS
4 - ROUTING TO OUTSIDE VPN

FIGURE 5: BREAK-OUT CALLING

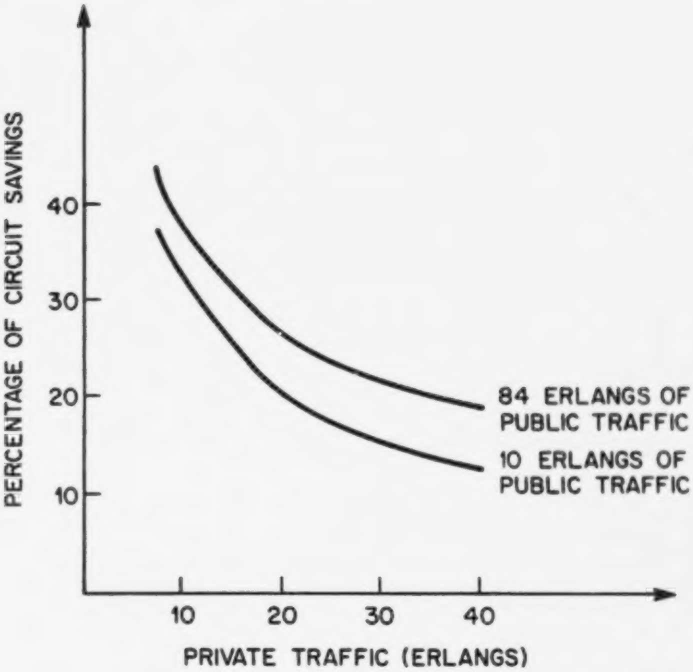


FIGURE 6: VPN CIRCUIT SAVINGS

6. *AT&T PERSPECTIVE*

AT&T is developing Virtual Private Network capabilities as both services and products. AT&T-Communications currently offers Software Defined Network (SDN), a virtual network service based on the AT&T public network. AT&T-Technologies is developing VPN capabilities as features supported on various switching, database, and support system products.

6.1 *AT&T-COMMUNICATIONS SDN*

SDN is a virtual network service designed to serve the needs of multi-location business customers. Based on the highly reliable and advanced AT&T PSN, SDN offers customers the benefits of the PSN with the features of a private network.

SDN ARCHITECTURE

SDN is based on a set of software defined primitives deployed in electronic stored program control switches and network databases which are interconnected with Common Channel Signaling (CCS). These capabilities are referred to as Direct Services Dialing (DSD) capabilities. The key network components include the Action Point (ACP),[3] the Network Control Point (NCP), the Network Services Complex (NSC), and the Service Management System (SMS) (see Figure 7). Through the SMS, a service support system, customers and service administrators define and control the service. These inputs are contained in the form of a customer record at the NCP, a centralized network database. During call processing, the ACP queries the NCP for call handling instructions and the NCP returns billing and routing information based on the SMS provided logic and data. The NSC, a switching subsystem, provides digit collection and enhanced announcement capabilities.

SDN FEATURES

Call Processing Features SDN customers will establish their own 7-digit numbering plans for calling to other stations on their SDN (on-net calling). In addition, SDN callers may also access POTS stations (off-net calling) via SDN facilities.

SDN provides customers the capability to screen on originating stations or caller entered authorization codes for allowable destinations. This feature also provides time variability so that certain screening may apply during particular hours of the day or days of the week.

In addition to voice calls, SDN supports analog data transmission up to 9.6 kbps and digital data transmission at 56 kbps. Data calls on SDN are handled by the NCP and may also be screened and selectively handled.

Transparent to callers, SDN provides for an interconnect arrangement with private networks. This will allow customers to combine existing private facilities in a hybrid arrangement if desired. In addition, this will ease the transition from private network to SDN by allowing customers to phase portions of their private networks to SDN while still preserving communications between all locations.

Operations and Administration The Service Management System provides customers with direct access and control of data and logic which is used by the NCP in call processing. Through a dial-up arrangement, customers may access the SMS and assign calling privileges, specify particular tones and announcements, and perform updates to the SDN service definition. In addition, customers will be able to make inquiries and request reports on service status information.

AT&T service maintenance personnel provide customer support from a control center dedicated to SDN service. These personnel are provided special tools to facilitate the resolution of service problems related to the SDN databases. These tools include such capabilities as testing the logic and data residing at the NCP to insure service integrity.

SERVICE EVOLUTION

SDN will be released in phases with new features and capabilities available to customers as the DSD architecture evolves. In future offerings, SDN customers will be provided such features as enhanced call screening capabilities, the ability to place international calls, and the ability to access SDN toll-free from off-net stations. In moving towards more economic and powerful access arrangements, SDN will allow for integrated voice and data access on a call-by-call basis.

In the longer term, SDN will evolve with the emerging AT&T PSN technology. For example, as ISDN capabilities are introduced in the network, SDN will benefit from the new features and capabilities derived from that technology. These will include such capabilities as receiving and forwarding station identification for improved call screening and billing detail. With an ISDN interface, customers will no longer require dedicated access lines for SDN and other AT&T switched services, and will be afforded the benefits of integrated access.

6.2 *IMPLEMENTATION OF A VPN WITH THE 5ESS*

The 5ESS™ Switch is AT&T's latest digital switch with a distributed architecture, consisting of an Administrative Module (AM), a Communications Module (CM), and Switching Modules (SMs). With its integrated Action Point (ACP)/Signal Transfer and End Point (STEP) capabilities, the 5ESS Switch can function as a VPN switching node either in a distributed or a centralized network environment. Briefly, the ACP functionalities include determining and executing necessary call processing actions required to route the call--this often entails exchanging messages with a database to receive call handling instructions. The imbedded STEP capability provides the ACP with a means of communicating with other ACPs and databases--e.g., routing a query through the CCS

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3. The ACP capability discussed here is presently deployed on the AT&T 4ESS™ Switch.

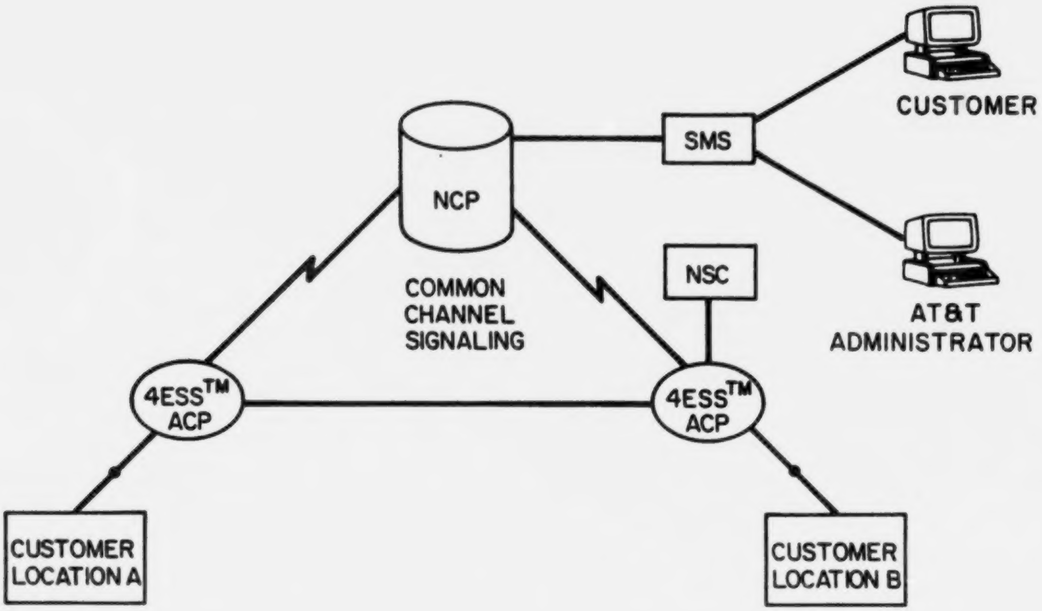
CUSTOMER
SMS
NCP
COMMON CHANNEL SIGNALING
NSC
AT&T ADMINISTRATOR
4ESS™ ACP
4ESS™ ACP
CUSTOMER LOCATION A
CUSTOMER LOCATION B

FIGURE 7: SDN ARCHITECTURE

network to a database.

The 5ESS Switch, capable of terminating analogue/digital lines as well as analogue/digital trunks, can serve as a local exchange, as a toll exchange, or even as a combined local/toll exchange. Consequently, subscribers terminating via local loops need not transit through other local exchange to access VPN (unless it is economically justifiable).

To accommodate subscribers far from a standalone 5ESS Switch, AT&T offers a Remote Switching Module (RSM) as part of the 5ESS Switch product line. Relying on a 5ESS Switch for various OA&M support functions, an RSM is basically a remotely located SM (or SMs) that has intra-office switching capabilities. A 5ESS Switch can extend its service to customers over 200 kilometers away by using either 24 or 30 channel PCM carrier systems or optical fibers as umbilicals to an RSM.

For those business and residential customers desiring to have a Centrex-type service, the 5ESS Switch has a solution: Business and Residence Customer Service (BRCS). Unlike other Centrex-type services that offer a limited set of features only to business customers, the 5ESS Switch offers customized feature construction capabilities that allow the switch owner to design a feature to meet the specific needs of each individual customer by uniquely combining a set of so-called building block feature capabilities. Moreover, flexible feature assignment capabilities of the 5ESS Switch allow any feature (or a set of features) to be assigned to any subscriber (or a group of subscribers)--including residential customers. With proper CCS networking among multiple 5ESS Switches, BRCS features/capabilities could potentially be offered as part of VPN service. As a result, compared to other typical VPN offerings that are primarily confined to network routing features, a 5ESS Switch-based VPN service can be extremely feature-rich.

7. *SUMMARY*

Virtual Private Networks are emerging as an economical alternative to dedicated private networks. This paper has presented a brief history of the evolution of VPNs from private networks and the typical implementation and features provided by a VPN. In addition, a brief and simple example was presented to provide insight on the circuit savings derived through VPN.

AT&T is taking advantage of the benefits of VPN through a new service offering and development of new capabilities on switching and database products. AT&T-Communications' SDN service was presented as an example of a powerful new virtual network service providing customers with a wide range of private network features and direct service control. A description of VPN offered on a 5ESS Switch demonstrates the synergy derived from integrating this modular switching system within the VPN concept. With evolving technology introduced in the public network, VPNs will remain a competitive state-of-the-art network service offering. In short, VPNs provide customers with a long-term sophisticated solution to their networking needs.

8. *ACKNOWLEDGEMENTS*

The author would like to express his gratitude to Tom Hudepohl and Dooyong Lee at AT&T Bell Laboratories for their help in preparing this paper.

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"Meeting User Requirements: A Networking Perspective"

A.L. Moore, Director of Business and Telecommunications Development
IBM World Trade Asia/Pacific Group

Notes

MEETING USER REQUIREMENTS: A NETWORKING PERSPECTIVE

A. L. Moore
Director of Business and Telecommunications Development
IBM World Trade Asia/Pacific Group

Abstract

The IBM Information Network is a value added network business that IBM entered in 1982. In the relatively short time the network has existed, it has grown to provide data communication and remote computing services to customers in over 200 United States cities. International links have recently been established and their use is growing. Some of the major customer applications currently provided by the network are described, and opportunities and strategies for future growth and development are discussed.

During this session, I will discuss the IBM Information Network, IBM's entry into the value added network business. To give you some history, IBM made a decision to provide the service in 1978, began development work in 1980, and started operations in 1982. So far, success has exceeded expectations, in that IIN is well ahead of the original business plan. We are delighted with the opportunity found and pleased that the offering has been accepted in the marketplace.

Let's begin by describing the IBM Information Network, IIN, as a data communications facility built on a comprehensive network that spans the United States and has links to Europe and the Far East. IIN allows users to attach several different ways. First, the user can attach directly either by dial or leased line. Second, they can attach their network to IIN's network by leased line, thereby providing all of their network users access to all of the facilities of IIN. Third, there are many users who have application programs and data bases that they want to make available to others around the country.

In this case we attach the users' processor to IIN, allowing access to the user processor to anyone who can interface with IIN. Fourth, there are large IBM computing facilities located in Tampa, Florida; Dallas, Texas; and Cary, North Carolina which users access and, in effect, make use of IBM's computing facilities as though they were their own. Finally, we also provide access to IIN, via Telenet, which further extends the network's reach. We want users to view the network as one that offers value added services either within their own organization, or between their organization and other companies, such as their dealers, their suppliers, or their customers.

The network provides access to a large variety of data bases, both those for general use such as Dow Jones, and the Official Airlines Guide, and those for specific applicants use like insurance or law enforcement. In addition, the network provides remote computing services whereby a user accesses the IBM owned computing facilities for application development, peak load requirements, or production work.

Now that I have described the principal services, let me give you a few examples of how these services are used. A large electronics distribution company is located in Los Angeles, California. They recognized the value of being able to do business electronically with their major customers and suppliers. Essentially, their choice was to go out and build a data communications network of their own to provide connectivity among themselves and their customer and suppliers, or to obtain a connectivity service from someone who already had a network in place. They chose to use the services of INN. Incidentally, I'm please to say we believe the decision they made a year and a half ago has been justified economically.

This company is one example of connectivity among different businesses. In general, we believe the generic intercompany connectivity application sometimes called Electronic Data Interchange, or EDI, is evolving rapidly in the United States. Strategically, this area is a prime opportunity for IIN.

An example of intra-enterprise use of the network is that of a employee retirement administration board, which is headquartered in Chicago. This board, a type of social security administration for certain retired workers, has locations in 75 cities around the United States. Their requirement is to provide users in each of these locations with direct interactive access to a host processor located in Chicago. This situation was a bit unusual, in that they did not have any in-house networking capability of their own. They were faced with the decision of building an entire intra-enterprise network from the beginning, or obtaining a network service from someone else. This organization chose to obtain the services of IIN.

The IBM Information Network, is a pervasive network with, as previously mentioned, three large processing centers in Tampa, Dallas, and Cary. It has some twenty major attachment points located throughout the United States which use IBM 3725's, 3708's, and Series/1's to allow users to attach either by dial or by leased line. In addition to these attachment points, there are roughly a hundred smaller centers located throughout the United States where users can attach to the network by dial line only. By year end 1987, there will be an additional hundred centers deployed bringing the the network to a total of over 220 connecting nodes. The network will then be within local dial-up range of somewhere between 70 and 80 percent of the population of the United States. In addition, users can have access to IIN through Telenet with it's many service points.

At this point, I'd like to mention that the network is built on IBM's Systems Network Architecture, or SNA. IIN is one of the largest and most complex SNA networks anywhere in the world, and it is used by the IBM Communications Products Division as a precursor of large complex IBM customer networks. Therefore, IIN is looked upon by IBM as being not only a major component of IBM's telecommunications business but also as a valuable source of user requirements for IBM's telecommunications development activities.

In order to successfully provide network services to a large number of users, IIN must provide these users with a high level of availability and reliability. To achieve this high quality, redundancy has been built into both the processor locations and the transmission centers. This commitment to availability and reliability has proven to be necessary to satisfy user network requirements.

In addition to providing high network quality, the IIN strategy is to meet user needs by providing a wide range of offerings that are attractive to users without regard to their job function or their industry type. Basically, the objective is for users to attach their networks to the IIN, to look at IIN as being an extension of the facilities that they provide in-house, and to use IIN for their data communication requirements with other companies with which they do business. Once attached, users often find additional services from which they may benefit, such as, electronic messaging, support for the business professional, and access to the various data bases that were previously referenced.

Based on the experience to date, we have concluded that a primary user need is in inter-organization connectivity. This application is currently being implemented on an industry segment basis. That is, there are various industry segments which appear to have requirements for intercompany connectivity. Most of our initial experience came from the property and casualty insurance area.

Many property and casualty companies use independent insurance agents to write and sell their policies. Early in the 1980's, we saw a requirement for any-to-any connectivity between independent agents and the property and casualty companies. This requirement gave birth to an insurance industry association. This association uses IIN to provide data communications and protocol conversion capability. There are currently some 50 property and casualty companies communicating with many thousands of independent insurance agents.

This same inter-enterprise concept is applicable in the financial services arena where companies such as, investment firms, credit companies, banks, brokers, etc. have a requirement to communicate with each other. Similarly, the need exists in the electronics distribution field, where the company previously discussed is an example. In net, the connectivity concept developed with the insurance industry association appears to apply equally well in many other industry segments.

Another intercompany application, which IIN is in the middle of implementing, has to do with the IBM company's desire to deliver services to it's customers electronically. The challenge here is how to deliver electronically, many of the services previously provided by IBM salesman and systems engineers. There are well over 20 individual sub-projects in various stages of development within the IBM company to explore the possibilities of electronic delivery of service to customers. For example, today customers can access a service called Info Express which brings together sales manual information, announcement letters, configuration tools and aids, financial planning models, software catalogs, etc. So, in effect, IIN is becoming an electronic interface between IBM and it's customers. More and more electronic services will be offered as this application evolves.

Another major connectivity need is between international users. Clearly, many users require data communication facilities on a worldwide basis. In recognition of this requirement, we added an intercontinental communication capability earlier this year. Conceptually, Tampa, Florida is used as a communications hub for the United States; Zoetermeer in the Netherlands is the hub for Europe; and Tokyo, Japan is the hub for the Far East. Now, a user in the United States who wishes to communicate with someone in another part of the world is able to do so, given that the other individual can connect to the Zoetermeer or Tokyo facility.

What has been covered with you today, is an overview of a value added network designed to provide solutions to evolving user needs. Currently it has users in several different industry niches, it provides access to a wide variety of third party data bases and software, and it provides connectivity among three continents. We believe that this type of network is just beginning to evolve, and that future user requirements will drive the development of more varied and sophisticated services.

CONCURRENT SESSIONS

SESSION 1

Overviews: Users & Service Providers

INTERNATIONAL PRIVATE USER NETWORKING: A BUSINESS PERSPECTIVE

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1. Abstract

Isolationism is dead not only as viable foreign policy, but also as far as corporate economic growth is concerned. This death has meant the birth of the multi-national, the transnational, and the global corporation. A corporation, as it faces increasing and more effective competition, must skillfully use every weapon in its arsenal. Efficient use of information as a resource and the ability to manage that resource over vast distances, requires that the multinational corporation closely examine the utilization of an international private user network.

2. INTERNATIONAL BUSINESS: THE LAY OF THE LAND

Recent years have witnessed a major transformation in the world's economy. This transformation is paving the way for multinational corporate expansion and fostering a new era of global competition. These forces have been well documented in business and academic literature and other fora. However, for a frame of reference, a few are highlighted here.

° Saturation of U.S. Markets

As the U.S. marketplace matures and reaches capacity, multinational corporations are expanding their businesses internationally. Thus, worldwide revenues are being derived from a much larger base of global markets. Today, most U.S. based multinationals obtain 30-60% of their revenues outside of the United States.

° Emergence of Non-U.S. based Multinationals

In the past decade, foreign multinationals have grown to the point that U.S. based multinationals account for less than 50% of the world's 500 largest industrial corporations. This has intensified global competition both in the U.S. (e.g. automobiles, steel, and electronics) and in the foreign markets being penetrated by U.S. based firms.

° New Wave of Protectionism

The proliferation of governmental efforts around the world aimed at protecting national employment and indigenous companies, renders competition more difficult.

° Deregulation of Industries

Deregulation has encouraged many companies to cross traditional industry product and service boundaries (e.g. banking brokerage, and insurance) and has caused increasing competition and consolidation in major industry groups like airlines.

° Major Growth in the Global Money Markets

Twenty-four hour trading windows in money and commodity markets are leading us toward a truly global economy

° Growth in Information Technology

Information Management is increasingly being identified as a resource used to enable the multinationals to achieve their strategic goals. Consequently, many companies are starting to take advantage of advances in information processing and telecommunications technology.

These and other environmental trends are changing the strategic focus of multinational competitors, who are now motivated to expand sales internationally and maintain respective market shares. This phenomenon is pointing them to obtain markets inside import barriers, find cheaper centers of production to serve regional markets, and to differentiate themselves and their products.

3. INFORMATION AS A STRATEGIC RESOURCE

Achieving a competitive advantage in today's global marketplace requires an understanding of the forces at play as well as a clear commitment to master new and innovative weapons.

Telecommunications use by corporations has matured from its early status as a necessary evil with costs to be controlled, to its current position as supportive of a company's tactical plan. Most businesses are still short, unfortunately, from integrating an information strategy into the corporations' fundamental business plan. If this is important for business in general, then it is absolutely essential to the multinational corporation as the demands for accurate, timely information grow, not diminish, as distances increase.

Many authors, including Gantz [3], Rackoff et. al [6], Terplan and Allen [7], have emphasized the evolution of information management into a "strategic weapon" for international firms. This implies that information must be viewed as a resource much the same as land, labor, or capital and, as such, must be managed with as much skill and adroitness as the more familiar factors of production and distribution. A further implication is: once International Information Technology Management is integrated into the corporate strategic planning process, it can be used to achieve a differential competitive advantage. Indeed, with proper application it can be used to restructure the way a companv or an entire industry does business.

Although not always obvious, the link between corporate strategy and use of international information technology is increasingly being documented. Companies, such as Harrod's Department Store in London, are expanding their international reach via the utilization of International 800 services, thereby increasing the cost effectiveness of distribution and marketing channels. Multinational petrochemical firms are differentiating themselves, with the aid of telecommunications, by becoming more adroit at spot trading and more effective at physical distribution logistics. Many international financial concerns are developing new business opportunities overseas by taking advantage of around-the-clock trading opportunities enhanced by well designed communications networks which are critical tools used to manage the corporate data resources. Finally, many multinational manufacturers are utilizing CAD/CAM technology over high speech digital links to lower production costs and improve product designs while taking advantage of geographically dispersed computer models.

4. THE BIRTH OF AN INTERNATIONAL NETWORK

The ability to apply information technology to the solution of a business problem depends, in a very real sense, on the corporation's ability to access that information. If we can establish that information itself has inherent value, then the ability to access it widely, quickly, and accurately render it more valuable. An efficiently operating international network will greatly facilitate a company's ability to do precisely that.

U.S. and foreign based multinationals are gradually extending their domestic networks to international points. Many times this effort is less than successful for a number of reasons. Most often, tactical applications are supported in a sequential, piecemeal manner resulting in an international "network" which is neither cost effective nor operationally efficient. An international network should be the result of a series of pre- planned and thought-out steps and not merely evolve. Application of several key principles will insure development of an efficient international network which, at its best, is supportive of the corporation's business strategy and enhances its ability to compete in the global marketplace.

4.1 PLANNING: DO WE REALLY KNOW WHY WE'RE DOING THIS?

Often, the Planning Phase of international network development receives less than adequate attention. This can be fatal as the cost, design, implementation, and utilization factors make these networks considerably more complex than their domestic counterparts. Therefore, at the start, it is imperative to assemble the strategic business criteria and operational factors which will form the basis for a business case for the project.

For example, a checklist of operational factors could include the following:

- Company demographics
    - Lines of Business
    - Functional lines (Marketing, Manufacturing, Finance)
    - Geography (Countries, Affiliates)
- Resources
    - Technical expertise
    - Existing network facilities
    - Budget
- Performance Objectives
    - Availability
    - Restore time
    - Reliability

These operational aspects are fairly obvious. However, they are rarely evaluated in terms of their relative project impact before the design phase has begun.

Much less frequently considered are the strategic criteria which determine not how the company uses its network, but more significantly, how the network can be used as a fundamental element of its business strategy.

These strategic criteria must be identified and evaluated. Rackoff et al [6] have itemized several categories of strategic thrusts which include: differentiation, cost, innovation, growth, and alliances. Each of these has distinct implications which may impact the network design. Once the appropriate strategic thrust, or thrusts, are determined, goal setting takes place. These goals are then translated into critical applications which lend themselves to information intensive solutions.

Having identified critical applications and prioritized operational objectives, the basis has been provided for the development of a business case. This will be used to demonstrate to senior management the additional value the international network brings to the corporation. The business case can be based on either measurable financial criteria (e.g. return on investment) or on other criteria such as projected incremental sales, defined competitive advantage, or superior public relations. Acceptance of the business case will thus lead to management approval and budget authorization. Additionally, the business case should establish the measurement of the success of the project and formally define project responsibility and accountability.

Increasingly, there are concerns regarding the development of international networks which are based on leased line backbone architecture. These concerns are primarily due to perceived trends toward an International ISDN and carrier provided software based network (e.g. SDN). Although these trends are very much part of the culture, it is still feasible to design, implement and operate a private network in a five to seven year time frame which would provide a payback to the corporation. Again, this is based upon the premise that the business case has been properly developed. The key ingredients regarding this issue are establishing the "economic" life of the network as defined by financial criteria and the application of design criteria which feature migration scenarios based on the company's long range business plan and projected technology trends.

4.2 THE DESIGN PHASE

Upon acceptance by top management of the proposal to develop an international dedicated network, the design phase begins. There are three stages to this phase:

1. the collection of data and preparation of input for the computation stage;

2. the computations that determine the optimal network parameters like network topology, link capacity, and the routing of traffic; and

3. the cost allocation process, which shares the cost of the proposed network among its beneficiaries -- the decentralized divisions -- in a "fair" way.

Data collection is an integral part of the design phase as the first cannot be carried out effectively without a clear picture of the design methodology that will be employed. Conversely, the availability of data will influence the choice of design methodology. For these reasons, the two tasks may overlap. The designer obtains the needed data and at the same time shapes the computation methodology accordingly through a sequence of information collection steps, involving both questionnaires and on-site visits or interviews.

Among the information requirements is data on the corporation's point-to-point telecommunications traffic, which may include a variety of applications, like voice conversations, electronic mail, interactive computer data, and facsimile. This effort should also consider such non-electronic media as mail and courier. The collection of this data is more complex with international networks for several reasons. Unlike domestic networks, where peak-hour traffic data is often sufficient, one needs the time distribution of traffic over the course of the twenty-four day when dealing with traffic on the global scale. This requirement is complicated further by the fact that traffic data must be collected in a number of countries, where the level of detail in the records kept by the phone companies differs, with many PTTs providing insufficient detail for network design purposes. The variable quality of PTT-supplied data internationally emphasizes the need for a well planned questionnaire and follow-up interviews and visits.

Present and future traffic data must be collected. Since a dedicated network will involve capital expenditures -- typically for customer-premises equipment-- the design should be done for a planning horizon comparable to the economic life of such equipment. However, while planning on the basis of projected worldwide policies, economic conditions, and technological innovation, one must keep in mind that such projections involve uncertainty and,therefore, attention must be paid to the robustness of the network design. A variety of migration alternatives to the future network will provide the desired flexibility and reduce premature equipment obsolescence.

A final ingredient of the data preparation process is information on the network services offered by the PTTs and the customer-premises equipment that is approved for use in the countries of interest. Varying regulatory policies across countries makes this a non-trivial task, underscoring again the need for a good questionnaire and local visits.

International private user network design is a complex computational task and, as such, requires the use of sophisticated operations research methodology, like the one presently under development at AT&T Bell Laboratories [1] [2]. While it is not the intent to present a comprehensive overview of this methodology, some considerations are cited in order to help the reader appreciate the complexity of the problem.

In determining the network parameters, a multitude of considerations come into play. Decisions must be made about the portion and mix of the traffic that will be routed via the dedicated network; at times the public network may provide a more cost-effective alternative than the dedicated network for certain origin-destination pairs and traffic types. In order to maintain high utilization on the dedicated lines, the traffic between a given origin and destination pair could be split between the two networks. Some traffic would get to the public network as a result of overflow from the dedicated facilities. Other traffic would be offered directly to the public network either because there exists no dedicated network path connecting the origin to the destination of the traffic, or because the circuits on such a path must be kept free to carry traffic in the opposite direction. The need for direction-specific routing arises in international networks because public facilities tariffs depend on the origin of the traffic, and therefore tariffs could be different for traffic carried in opposite directions. Finally, care must be taken to design for sufficient capacity to carry traffic within an acceptable range of network performance quality.

An added degree of complexity in international network design arises from the noncoincidence of business hours, which while correctly perceived as a source of concern, has also some redeeming effects. As Benveniste [1] explains, "the noncoincidence of business hours in cities around the globe makes business telecommunications traffic between distant cities highly peaked and causes peaks along different routes to occur at different times. Whereas the high peakedness may discourage the use of dedicated services along such routes, the noncoincidence of the traffic peaks on different routes provides the means by which dedicated services could be made cost effective. By combining noncoincident traffic through indirect routing, one can increase the utilization of certain links on which dedicated services could become cost effective". An example is a brokerage firm with offices in cities with important financial markets, such as New York, London, Geneva, Singapore, Tokyo, and Sidney. The time-zone differences from city to city around the globe shift the overlapping business hours, during which trading and, consequently, voice traffic occur. By reconfiguring the network in the course of the day, one could use the same link, say the Sidney-New York link, to carry at different times the traffic between various pairs of cities, like Hong Kong and Geneva or between Singapore and London, thus increasing the utilization of the link.

Knowledge of the time profile of traffic provides and additional benefit: it enables one to increase the throughput of a dedicated network by using the idle capacity during low usage periods for off-peak applications, such as low priority electronic mail or computer batch jobs. The same channels could be used at different times to move traffic as diverse as voice conversations in the circuit switched mode and interactive computer data in the packet-switched mode.

Having obtained a detailed network design to defend the contention that a dedicated international network will bring net gains to the corporation, one needs to ensure its acceptance not only by top management, but also by the decentralized division managers if buy decisions require their consent. Since the network was designed with the goals of top management in mind, it is expected it will win top management's acceptance. It is not always true, however, that divisional management will take the same position, as their goals may be different from those of top management. Consider, for instance, the corporation that evaluates divisional management on the basis of measures that depend on their expenses; such measures would be divisional net profits or expenses to revenues ratio. If the divisions are charged the cost of the shared network and their performance measures are affected, they may have reason to oppose the adoption of the new network. To make their decision congruent with that of top management, one must devise a network cost allocation scheme that will improve or leave their performance measures unchanged. When several cost allocation schemes with this property are available, one can be selected based on equity considerations. For example, a division's cost share could be made proportional to the alternative telecommunications costs escaped. With the proposed network's costs allocated, one is ready to present the design to the corporation's management confident that top management's strategic goals will be served and assured of divisional management's congruence.

4.3 IMPLEMENTATION: PULLING IT TOGETHER

Implementation is the third major phase in an international networking project. At this point, having convinced senior management that the project will have a positive net effect on the corporation, the implementation must be completed in a smooth and timely manner. Almost by definition, international network implementation is a very complex and time consuming exercise because of unique environmental and operational aspects.

For example, a given international network will always have a multi-vendor character which includes a variety of carriers (U.S. based and PTTs) and equipment manufacturers. This fact requires that the implementor use a disciplined system for coordinating a critical provisioning path. This path usually involves varying order procedures (i.e. matching orders required on each end) and multiple installation intervals for the circuits and equipment. Network engineering activities are impacted because "end to end" transmission plans also involve several vendors/carriers and require extensive coordination.

The post cutover activities such as user training, network management, and network maintenance are heavily impacted by environmental factors. Time zone variances, language differences, and different levels of technical expertise are all complicating considerations. These impact the post cutover activities which are critical to the ongoing efficacy of the network. In developing the procedures and logistics to handle training, maintenance, and management, it is advisable to organize a "core" team composed of users, vendors, and telecommunications management personnel. This team should be charged with developing control mechanisms, monitoring tools and tracking techniques which are consistent with telecommunications management principles and end-user expectations.

Often, users are looking for one or several vendors to coordinate the implementation phase because of the complexities and problems involved. However, regardless of vendor support it is incumbent upon the users to keep their own "house in order" via sound project management procedures. Ideally, an official in-house coordinator should be appointed having matrix management authority as well as appropriate responsibility for direction and follow through.

Once the network has been implemented, on-going performance reviews with senior management are appropriate. These reviews should ideally include a brief summary on technical performance (using verbiage which can be readily understood by nontechnical managers) and on going business performance as defined by the business case criteria.

5. BOTTOM LINE: IS IT WORTH THE EFFORT?

Planning, designing, and developing an international private user network is an expensive and time consuming process. However, if done properly, a no-lose situation has been created for the corporation. If the business case has been constructed with good inputs and assumptions, the corporation will benefit strategically upon implementation of the network. On the other hand, if the development of a network is not substantiated by the business case and the proposed design, the corporation still benefits by virtue of having attained a much better perspective of their global strategy and international operations. This would enhance the ability of the telecommunications staff to make on going adjustments to the existing network or use public switched services in a way that supports the corporation's objectives.

Isolationism is dead not only as viable foreign policy, but also as far as corporate economic growth is concerned. This death has meant the birth of the multi-national, the transnational, and the global corporation. A corporation, as it faces increasing and more effective competition, must skillfully use every weapon in its arsenal. Efficient use of information as a resource and the ability to manage that resources over vast distances, requires that the multinational corporation closely examine the utilization of an international private user network.

This process begins at the corporate strategy level and proceeds through planning, data collection, design, implementation and evaluation. Each of these are fraught with complexities and require business acumen, skillful utilization of resources, application of powerful mathematical tools, managerial insight, and finally plain hard work. If done properly, even at worst, the corporation will gain a keener insight into where it's going. At best, it will have at its disposal a cost effective and operationally efficient network which facilitates its worldwide information movement and management.

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PPAC PRIVATE PACIFIC CABLE BETWEEN THE U.S. AND JAPAN

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1. Abstract

PPAC stands for Private Pacific Cable which will cross the ocean a distance of 9500 kilometers from Seattle, WA with a branch to Anchorage, Alaska, and land in Japan near Tokyo creating a high capacity digital fiber optics bridge between the United States and Japan.

1. Good day. I want to thank the Pacific Telecommunications Council and the PTC '87 program committee for the opportunity to speak to a group whose principal concern is telecommunications serving the Pacific rim. What I have to talk about today I hope will be of major interest to you.

2. PPAC stands for Private Pacific Cable which will cross the ocean a distance of 9500 kilometers from Seattle, WA with a branch to Anchorage, Alaska, and land in Japan near Tokyo creating a high capacity digital fiber optics bridge between the United States and Japan.

3. This is a simplified map of the system showing the route and the landing points of PPAC.

4. PPAC begins its Pacific journey from Washington State. This new fiber will bring a new telecommunications dimension to the Northwest which has long been a major transportation center serving the nations on the Pacific rim.

5. PPAC will connect into existing fiber systems running down the U.S. West Coast and will connect into the major existing and planned digital networks crisscrossing the U.S.

6. PPAC will also provide the state of Alaska with new communications facilities to supplement its extensive satellite-based facilities and it will provide new diversity for essential national security links between Alaska and the lower 48.

7. For Japan, this new cable, which will land near Tokyo, will provide new facilities for the nation with the highest projected telecommunications traffic growth in the Pacific and provide new opportunities for the Japanese as they move forward into deregulation and privatization.

8. PPAC will be built and operated by a joint venture composed of Pacific Telecom Cable and a Japanese consortium. Pacific Telecom Cable, 80% owned by Pacific Telecom and 20% owned by Cable and Wireless, applied to the FCC in June, 1986 for a cable landing license.

   A Japanese consortium, which will apply shortly for a license to operate as an alternative international carrier, will provide for a landing site and interconnection to Japanese users through other Japanese domestic common carriers.

9. Pacific Telecom, Inc. is a diversified telecommunications firm headquartered in Vancouver, Washington, with assets over $1 billion. In addition to being one of the nation's largest non-Bell telephone companies, Pacific Telecom has augmented traditional operations with ventures into new and promising market segments. The Pacific Telecom organization includes more than 35 companies--from core activities in telecommunications, to diversified activities in nonregulated telecommunications, information systems, and high technology electronics.

   Pacific Telecom's long lines carrier, Alascom, Inc., is headquartered in Anchorage, Alaska and provides a full range of long distance telecommunication services to all areas of Alaska, and between Alaska and the rest of the world. Alascom's network includes three regional switching centers, some 200 satellite earth stations operating in conjunction with a company-owned satellite, and six major microwave radio systems stretching across some 3,000 miles.

   Pacific Telecom's local telephone operations provide services to over 195 communities in nine states.

10. **From its Vancouver, WA headquarters, PTI directs its farflung diversified activities, including companies involved with: national and international network services, teleports, cellular telephone, alternative long distance, advanced avionics systems and other emerging technologies.**

11. PTI is not waiting, however, until PPAC becomes operational. Through its National Gateway Telecom, Inc., (NGTI) subsidiary, PTI has begun serving this Pacific region market with international business services offering 56 KBS and higher speeds in 1987 between San Francisco and Tokyo and the Far East. IBS services from the Bay area Teleport in San Francisco also are being offered to Europe and serve as a bridge between Asia and Europe.

12. As you are all aware as Pacific telecommunicators, Cable & Wireless is a worldwide player in this field with a long history and an even longer list of operations stretching from London all around the globe.

    In addition to the long list of telecommunications services offered by the companies listed on this slide, C&W operates the largest fleet of cable laying ships in the world and has over a century of experience in underwater cable installation and operation.

13. From its headquarters in London, C&W manages its telecommunications operations in the U.K., the Atlantic, the Caribbean, the U.S., the Middle East, Africa, Hong Kong, and here in the Pacific.

14. PTC is currently holding discussions with several Japanese entities with the purpose of bringing them into a joint venture to operate the Japanese end of PPAC.

15. The objectives that PTC has established as it moves forward on the construction of the cable are:

    . To build a digital fiber optic highway across the broad Pacific Ocean.

    . To meet the burgeoning demand for telecommunications which exists between Japan and North America.

    . To provide the users with viable alternatives in their choices for carrying increased traffic loads.

    . And to connect Alaska back to the U.S. lower 48 for national security purposes and to provide additional diversity for communications facilities in the 49th state.

16. The 9500 kilometer system (roughly 6000 miles) contains 840 MBPS of capacity with each of three fiber pairs operating at 280 MBPS. This is comparable to carrying 18 DS-3 facilities or 12,000 simultaneous phone calls without use of any circuit multiplication techniques such as DSI and compression.

    The digital system will offer:
    - voice
    - data
    - video
    - enhanced or valued added services

17. The projected cost for PPAC is $500 million and it is planned to become operational by late 1989. Capacity on PPAC will be sold on the U.S. side on a non-tariffed, non-common carrier basis to various users. Capactiy on the Japanese side will be subject to new Japanese telecommunications laws which foster competition.

18. This chart looks at the various component milestones in the PPAC system but hopefully it also shows PPAC well in business by year end 1989.

19. With deregulation in the U.S., non-dominant carriers are permitted to build, operate and lease transmission systems on their own and offer capacity to users competitively based on new technology and low cost. In terms of private cables, the FCC has ruled that such operations are not classed as common carriers and not subject to regulation under Title II. PPAC filed only to meet Cable Landing License Act requirements.

20. With privatization in Japan, the process of licensing of a second international carrier to compete with KDD is currently underway to maximize private sector participation and to offer new technologies and lower costs arising from competition.

21. The prospective users and customers for PPAC are:
    - Major manufacturers using CAD/CAM
    - Financial institutions.
    - Corporate users with high traffic volumes
    - Common carriers, resellers, and value-added networks
    - And prospective government agencies on both sides of the Pacific.

22. The filing that Pacific Telecom Cable made to the Federal Communications Commission for PPAC received only one comment and that was a favorable one from the Department of Defense which felt that PPAC would serve national security purposes by providing diverse routing.

23. **With its high digital speeds, PPAC is capable of meeting market demands for ever higher data rates and a whole shopping list of new voice, data and video services.**

24. The rate of traffic growth to Japan up to 1995 is said to be 30%. PPAC hopes to serve that growing demand for telecommunications here in the Pacific basin.

25. Pacific Telecom Cable has been a wonderful marriage of convenience because each of its principals can provide its own experience and expertise in those areas which it knows best. This sharing of PPAC's responsibilities is graphically shown here.

26. Although submarine cables have been around for more than a century, new technology and innovative laying techniques have brought undersea cables into the world of high tech. The PPAC system contains not only cable which will carry the fiber strands but utilizes repeaters that regenerate signals and provide supervisory functions. Branching units will permit landing of the cable in three sites where terminal equipment provides multiplex as well as supervisory and power functions.

27. The multi-fiber cable in PPAC permits the system to run a spur to Alaska from the main cable, and also permits diversity, restoral and service protection features.

28. As we move into the digital world and while many communications companies have to wait out the depreciation tables on existing analog systems, PPAC, as a digital high speed facility, will be completely compatible to the ISDN standards that are now beginning to emerge.

29. As mentioned earlier, C&W (Marine) has the largest cable-laying fleet in the world. This picture of a cable ship shows a modern vessel of the type that will be used to install PPAC across the Pacific.

30. A simplified diagram like this doesn't even begin to portray the topography of the harsh environment that exists on the sea bottom. A cable laying ship must survey and lower cable through canyons and mountain ranges that would appear formidable even if they were not in the lower depths.

31. This enlarged view showing a typical fiber with its core, cladding and coating only measures between a 32nd and 16th of an inch in diameter. In an ocean environment it becomes necessary to protect this fragile strand of light-carrying fiber.

32. A typical undersea fiber optic cable is shown where multiple fibers are enclosed in a core package which is surrounded by twisted high strength steel wires. A copper conductor sheath contains the steel wires and the cable is then enclosed in a wrapping of insulation material.

33. Despite its seeming impenetrability, an underseas cable is subject to various dangers such as ship anchors, fishing nets, seismic activity, mud flows, and marine life that can cause problems ranging from insulation damage all the way to a complete break. Luckily with today's remote monitoring functions and the modern repair ships with remote operating vehicles, cables can be quickly repaired and restored to full operational capability. This series of diagrams show how a repair ship accomplishes a new splice when trouble has occurred and restores the cable to full service.

34. I thank you for your kind attention. We at PTC are certainly looking foward to that time when we can be invited back to the PTC '90 annual conference to report directly to you on the successful startup of the first Private Pacific Cable operational across the Pacific.

The FCC's Promotion of International Competition: Has It Helped the User?

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1.0 ABSTRACT

The U.S. Government, primarily the Federal Communications Commission, has since 1980 instituted a number of policies to encourage competition in the international telecommunications market. Some policy initiatives have largely succeeded, while others have failed for various reasons. Overall, however, the U.S. telecommunications users have benefited from these policies. The number of service providers and service choices have increased and costs appear to have been lowered.

2.0 INTRODUCTION

The United States, practically since the initiation of telecommunications services here, has been unique in comparison with the rest of the world. This uniqueness stemmed, of course, from its almost total reliance on private firms to provide international communications services to the public and to the government. Most other nations, as you know, have relied upon either government ministries or government-owned corporations. These two very different regimes developed over time a workable, even at times comfortable, relationship under the tutelage from the U.S. side of the Federal Communications Commission (FCC). When the decade of the 1980s began there existed in the United States an oligopoly wherein a relatively few companies controlled various segments of the international telecommunications market. American Telephone and Telegraph (AT&T) was the sole provider of international telephone service from the mainland of the United States. A handful of international record carriers (IRCs) provided telex and telegraph services. The three largest IRCs controlled, for example, 91.8 percent of the international telex market in 1980. (See Figure 1.)

COMSAT was the monopoly supplier of INTELSAT space segment services and effectively controlled international earth station services through Earth Station Ownership Consortiums (ESOCs) established to own the then-six U.S. gateway INTELSAT earth stations. In each ESOC, COMSAT owned a 50 percent share and, in all but one case, it also managed the day-to-day operations of the six earth stations. (The sole exception was Guam, where the earth station was operated by RCA Global Communications.) The remaining 50 percent ownership in the stations was divided among the major IRCs, AT&T and the Hawaiian Telephone Co.

Since 1980, however, the U.S. Government -- primarily the FCC, but also the U.S. Congress, with the support of two different Presidents, Carter and Reagan -- has attempted through a variety of policy initiatives to encourage competition among international telecommunications service providers. The underlying assumption of these initiatives was that the stimulation of competition within the industry would ultimately benefit the user of international telecommunications services. Such benefits would include reduced costs for service as competitors cut prices in order to attract and retain customers. It was assumed and hoped, too, that users would be presented with greater choice in both service providers and types of services, as new entrants to the market and established operators attempted to win customers by offering new or unique services.

Some evidence now exists that allows us to make at least preliminary assessments of the success of these policy initiatives. Below, I intend to review certain key policy decisions and assess their impact on the user. I hope that my rather brief assessment here will give U.S. and foreign service providers and users much to think about and will stimulate those in academia to undertake further research into the efficacy of U.S. pro-competitive policies.

3.0 "UNLEASHING" THE FORCES OF COMPETITION

Efforts by the U.S. Government to encourage competition have often come about in a piecemeal fashion, primarily through FCC inquiries that culminate in the issuance of an order stating the Commission's policy on the matter. At other times, as in several of the matters related to COMSAT, the FCC has conducted simultaneous inquiries on a number of matters, moving in essence along a broad policy front. Discussed below in more or less chronological order are some of the major FCC policy decisions which either were thought would or actually have had a major impact on the international telecommunications market.

3.1 THE COMPUTER II DECISION

The FCC, in the spring of 1980 once again attempted to draw a dividing line between the

FIGURE 1

Combined* Revenue Shares,
International Record Carrier Industry,
1980-1985 (30)

Carrier	1980	1981	1982	1983	1984	1985
FTC Communications	1.3	1.8	2.0	2.4	3.0	3.5
ITT World Communications	34.3	33.5	34.4	33.5	30.0	28.8
RCA Global Communications	33.2	31.0	29.2	31.1	30.2	30.1
TRT Telecommunications	6.8	8.2	9.1	9.1	9.8	10.9
Western Union International	24.3	25.5	25.1	23.9	21.4	19.8
Western Union Telegraph	0.0	0.0	0.0	0.0	5.6	6.9

*Combined telex, telegraph and private line service revenues.

increasingly intertwined services of telecommunications and computer processing. Its goal was to separate out those services associated with computer processing so that they could be deregulated. In concluding its so-called second computer inquiry or Computer II, the FCC divided the two types of services into "basic" and "enhanced" categories.

"Basic" services were those normally thought of as traditional common carrier services, i.e., the provision of lines of communications. Enhanced services were defined as "services, offered over common carrier transmission facilities used in interstate communications, which employ computer processing applications that act on the format, content, code, protocol or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different, or restructured information; or involve subscriber interaction with stored information." (1) As important as the definition was the fact that enhanced services were not to be regulated under the common carrier portion of the Communications Act of 1934, the primary statute by which the FCC regulates domestic and international telecommunications. (2)

Almost as an afterthought, or so it seemed, the FCC extended the basic/enhanced dichotomy to international telecommunications as well. This set off a storm of controversy. The conventional carriers were concerned that foreign administrations would interpret this order as condoning the resale of common carrier lines for the provision of enhanced services. Some new service providers, such as GTE Telenet, which had only recently obtained certification from the FCC as international common carriers, suddenly found that they would be deregulated and decertified, thus losing their stamp of legitimacy, as perceived by foreign administrations.

These questions generated repeated appeals, petitions and other devices by which the controversy dragged on for five years before the FCC. The FCC has stood fast to its extension of the basic/enhanced dichotomy to international services. (3) In the process, however, U.S. Telenet (formerly GTE Telenet), at least, has managed to retain its designation as a common carrier.

3.2 THE RPOA ORDER

To undo the potential harm its decertification of international enhanced service providers may have caused, the FCC in May 1986 issued an order establishing procedures by which enhanced service providers and users could obtain Recognized Private Operating Agencies (RPOAs) status. RPOA status under this policy will be made available to enhanced services providers who offer packet switching, code and protocol conversion, services that act on the form but not the content of the communications, and electronic mail or other store-and-forward type services. The FCC, in enacting this policy, felt that foreign administrations would be assured that an enhanced service provider, though not under the FCC common carrier regulatory oversight, would adhere to the International Telecommunication Convention and the regulations of the Consultative Committee for International Telephone and Telegraph (CCITT). (4)

In any case, the problem the FCC sought to solve with its RPOA decision seems to have existed on a smaller scale than was anticipated. Since the release of the order, only one company has sought RPOA certification. Other superficial evidence also seems to indicate that the Commission's Computer II Decision has not hindered international enhanced services providers and may have indirectly helped them by making the U.S. domestic market a more fertile environment for their growth and proliferation.

A report prepared for the National Telecommunications and Information Administration (NTIA), a part of the U.S. Department of Commerce, identified 35 different U.S. firms offering database services to various regions of the world. As many as 27 U.S. firms offer data processing services to Europe, Canada and East Asia, with lesser numbers of firms offering the same services to other regions. The report indicated that at least some firms are having problems operating overseas. However, many of these problems were unrelated to foreign or U.S. telecommunications regulation and policies directly, but rather, fall more within the area of trade and business regulation. The number of firms offering services, however, indicates that despite problems of various sorts, U.S. enhanced service providers are doing a significant amount of business abroad. (5)

In the same order, the FCC took an additional step to promote competition and user rights. It permitted enhanced service providers and users to acquire indefeasible rights of use (IRUs) in undersea cables. It did not immediately require that IRUs be made available by carriers, instead giving them the option of doing so. The FCC also allowed the price for the IRUs to be negotiated between the parties. However, the FCC said that when the high capacity fiber optic TAT-8 cable (and by inference, the Haw-4/Transpac-3 fiber optic system in the Pacific) come into service in 1988, it would consider requiring carriers owning these cable circuits to offer IRUs to non-carrier entities.

So far, no IRU sales by carriers to enhanced service providers or users have been reported to the FCC. However, this policy could have far-reaching effects in the era of abundant fiber optic cable capacity that will arrive by the end of the decade. At that time, users will, for the first time, have direct access to raw telecommunications facility capacity, at least at the U.S. end of the circuit. It remains to be seen, of course, whether foreign administrations which own the matching cable half-circuits will either agree to also sell IRUs in their half-circuits or to operate directly with the users and enhanced service providers.

3.3 THE RECORD CARRIER COMPETITION ACT

The next major effort to reshape the international telecommunications market was made by the U.S. Congress when it approved the Record Carrier Competition Act (RCCA) late in 1981. (6) The act essentially allowed Western Union Telegraph Co. (WUTCO) back into international telecommunications, from which it had been barred for some time. The RCCA and the policies propounded by the FCC to implement it also allowed the IRCs to offer international services from anywhere in the United States and to offer domestic services, as well. Previously, they had been restricted solely to offering international services from a few "gateway" cities. To achieve equity, a significant degree of interconnection among the networks of the major IRCs and WUTCO was ordered.

Evidence indicates that the RCCA added to competitive forces already at work in the international record market even before enactment of the RCCA. Smaller carriers had in the late 1970s begun to pick up market shares at the expense of the established, larger "Big Three" - RCA Global Communications, Western Union International (now a subsidiary of MCI International), and ITT World Communications. This trend has continued so that the Big Three's combined shares of the IRC market has been reduced to 78.7 percent in 1985. (See Figure 1.)

The earnings ratios of the various record carriers indicate that competition has driven down the profit margins of the IRCs significantly. (See Figure 2.) This compares with the results of an FCC audit released in 1980 which found excessive profits in the record industry and little price competition. (7) Telecommunications users have benefitted both from the flexibility, due to the interconnection requirements, and from price competition encouraged by the RCCA. A survey released last year of the domestic and international telephone and telex rates of seven selected countries in North America and Europe found that only in the United States did rates for both domestic and international telex go down between January 1, 1985, and January 1, 1986. (8)

3.4 LIFTING TAT-4 RESTRICTIONS

A less successful FCC attempt to inject competition into the international telecommunications market was its lifting in 1982 of the so-called TAT-4 restrictions. In 1964, the FCC had restricted AT&T to the provision of international

FIGURE 2

Earnings Ratios* of International
Record Carriers (30)

Carrier	1980	1981	1982	1983	1984	1985
FTC Communications	[55.7]	[75.6]	[39.8]	[29.3]	[12.4]	10.5
ITT World Communications	22.6	18.9	14.6	8.1	4.2	11.3
RCA Global Communications	11.3	8.0	4.9	8.3	3.2	4.4
TRT Telecommunications	40.2	45.0	35.3	27.2	18.5	20.8
Western Union International	15.1	15.6	8.7	8.4	1.8	[9.0]

$$\text{*Earnings ratio} = \frac{\text{Net Operating Income [after taxes] + Interest Charged to construction}}{\text{Average net communication plant, including plant under construction}}$$

voice services in order to assist the IRCs in gaining access to undersea cables and to preserve for them the emerging alternate voice/data service. The origins of the prohibition against international record carriers providing voice services was less clear, but the result was the segregation of the record and voice markets. The division frayed somewhat in the international leased line service. AT&T provided essentially voice-only private line service, though Datel-type traffic flowed over such lines regularly. The record carriers were restricted to providing data or alternate voice/data (AVD) leased lines, though no one monitored how much of the traffic was voice and how much data. The FCC hoped that lifting the TAT-4 restrictions would draw AT&T into the record business, and the record carriers into the burgeoning voice business. (9)

Neither situation has developed, however. AT&T has not to any large extent entered the telex or telegraph business. The IRCs have been similarly reluctant to enter the voice market. Only TRT Telecommunication has introduced international voice services, primarily for service between New York and London. (10) Competition in the international leased line market also appears not to have lead to significant shifts in market share. (See Figure 3.)

FIGURE 3

Carriers' International Private
Line Service Revenues (30)
(Omits 000)

Carrier	1981	1982	1983	1984	1985
AT&T	$5,090	$4,777	$4,985	$4,874	$6,735
FTC Communications	4,074	5,411	6,478	8,758	10,090
ITT World Communications	36,045	39,645	45,698	48,940	53,083
RCA Global Communications	40,285	42,867	47,412	51,784	54,860
TRT Telecommunications	4,576	5,368	6,101	7,127	8,838
Western Union International	26,871	30,431	33,209	32,521	34,476
Western Union Telegraph	0	0	0	1,263	2,004

In sum, the IRCs concerns at the time the restrictions were lifted, that AT&T would crush them, have proven to be unfounded. The FCC's hopes that new competition in the voice and record markets would result have proven to be equally false. This policy failure may have been due to an underestimation by the FCC of the barriers to market entry for the respective parties. It may have also been due to the IRCs' predisposition and AT&T's perception of the direction of the international telecommunications market. While telex traffic was then and has continued to grow annually, AT&T may have heeded the predictions that digital data communications was the wave of the future and decided to focus its attention on international enhanced services through its subsidiary (created as a result of Computer II) AT&T Information Services. The IRCs, on the other hand, without a domestic long distance telephone subscriber base upon which to build an international switched voice business, have apparently decided to concentrate their efforts in their existing market, while perhaps competing more vigorously in the international leased line business.

3.5 ENTRY OF NEW VOICE CARRIERS

Competition in the international voice market has instead come from the entry of AT&T's domestic long distance competitors, primarily MCI and US Sprint. MCI won initial authorization to provide international switched voice service in early 1984 and Sprint, in early 1985. (11) Today, MCI provides service to over 40 countries and US Sprint to around 30. Other domestic competitors, such as Allnet and Cable & Wireless Communications have also entered the market on a smaller scale.

However, as shown in Figure 4, neither MCI nor Sprint has been successful in obtaining shares in the international voice market commensurate with their success domestically. This could be because their domestic customers are not those who make frequent international calls. The reluctance of certain key administration to sign operating agreements with them, such as France, Germany and until recently Japan, may have also hindered their growth.

In any case, the prospect, as much as the existence, of competition in the international voice market appears to have lead to a lowering of user costs. Telephone carriers' revenues per minute have generally declined since 1980, indicating a lowering of rates. (See Figure 5.) The survey of seven countries noted earlier also found that charges for international calls between 1985 and 1986 had declined 23.37 percent, no doubt attributable to rate cuts by AT&T. Such rate cuts have continued, matched by MCI and Sprint. (12) Therefore, while the market shares of AT&T's competitors may not be very large, the effect of their entry or prospective entry seems to have benefitted international telecommunications users by encouraging AT&T rate cuts.

FIGURE 4

International Message Telephone Service Carrier
Market Shares from Mainland U.S. (CONUS), 1985 (30)

	IMTS Originating CONUS			IMTS Terminating CONUS			IMTS Combined CONUS		
	Messages	Minutes	Revenues	Messages	Minutes	Revenues	Messages	Minutes	Revenues
AT&T	98.5%	98.4%	98.4%	98.1%	99.1%	99.2%	98.8%	98.7%	98.8%
MCI Int'l	1.2	1.2	1.3	1.1	0.8	0.7	1.1	1.1	1.1
US Sprint	0.3	0.4	0.3	0.1	0.1	0.1	0.3	0.3	0.2

FIGURE 5

Revenue Per Minute For
International Message Telephone
Service, 1975-85 (30)*

1975	$0.91
1976	0.87
1977	0.83
1978	0.72
1979	0.87
1980	0.77
1981	0.53
1982	0.44
1983	0.42
1984	0.42
1985	0.47

*1975-84 AT&T only, 1985 includes MCI and US Sprint.

3.6 EARTH STATION OWNERSHIP

The international satellite communications segment of the industry, dominated at the start of the decade by COMSAT, did not escape FCC attempts to inject competition. The Commission did this across a series of fronts, ordering COMSAT to restructure itself (13), authorizing international telecommunications users to take service directly from COMSAT (14), though deciding not to authorize direct access to INTELSAT. (15) Perhaps the FCC's most far reaching action was to authorize the break-up of the ESOCs and to liberalize earth station authorization procedures for INTELSAT International Business Services (IBS) and television transmission services in its Earth Station Ownership Decision in December 1984. (16)

In that decision, the FCC authorized the ESOC partners to negotiate the dissolution or reshaping of their partnership. Some ESOC partners had advocated dissolution or renegotiation due to FCC policy changes. The TAT-4 Decision had made AT&T and the record carriers, at least nominally, competitors. Competition between the heretofore rather clubby IRCs had also increased, as noted above. Finally, the Commission's Authorized User Decision had made COMSAT, until then strictly a wholesaler of INTELSAT earth station and space segment services, a potential retail services competitor.

The Earth Station Ownership Decision accentuated the role of COMSAT as a competitor. It ordered COMSAT to divide its previously combined operations into a division offering INTELSAT space segment capacity on a monopoly basis and a retail services subsidiary. That subsidiary, dubbed Comsat International Communications, Inc., would operate the ESOC stations and would be allowed to compete in the newly created IBS and television earth station services market.

The FCC's policy decision had several intended and unintended effects. An unintended effect was COMSAT's decision, announced in May and June 1985, to sell its ownership interests in the Guam and mainland U.S. earth stations to RCA Global Communications and AT&T respectively. This development was not anticipated, apparently, by the FCC (17), but was a logical result of one element of the FCC's decision. COMSAT had urged that AT&T be barred from constructing gateway-type earth stations, essentially to insure that AT&T's traffic would continue to flow to the existing gateway earth stations, in which it and its ESOC partners (including AT&T) had substantial investments. Without such a prohibition, COMSAT feared that AT&T would build its own stations and transfer its traffic from the existing stations. Since AT&T provided more than 85 percent of the traffic to the mainland U.S. gateway stations, such a transfer would have undermined the economic viability of these stations. However, the FCC declined to bar AT&T from building its own gateway stations, though it said it would review carefully any application to do so. COMSAT obviously felt vulnerable.

The sale of COMSAT's interests in the mainland earth stations to AT&T is scheduled to take place on January 1, 1988, at which time AT&T will have a 97.5 percent ownership share in the stations. Already, plans are underway to reconfigure the earth station network to suit AT&T's needs. Two stations, at Brewster, Washington and Andover, Maine are to be closed. AT&T has already taken over a large domestic earth station complex previously operated by GTE near Los Angeles and plans to convert one of its antennas so that it can be used for international services.

If the FCC approves the transfer of control from COMSAT to AT&T, AT&T will gain control of both primary bottleneck facilities used for international telecommunications traffic, undersea cables and international earth stations. (Applications requesting authority to carry out the transaction have not yet been filed.) Equitable interconnection requirements will no doubt be imposed on AT&T by the FCC, if it approves the transfer. However, the transfer may well turn out to have subtle anti-competitive effects, should AT&T make the cost of services through these earth stations for its competitors sufficiently high. AT&T's competitors will, of course, have the option of building their own earth stations for switched services, but this is a costly alternative. Only time will tell whether the Commission will be forced to increase its regulatory oversight of the international earth station market as a result of the Earth Station Ownership Decision.

Liberalization of ownership restrictions on IBS and television earth stations has been more obviously successful. By late 1986, the FCC had approved the applications of more than 30 organizations to become IBS carriers, authorized the construction of more than 50 IBS earth stations and six earth stations for international television exchanges. (18)

The IBS market appears to be booming, at least in the Atlantic. INTELSAT's IBS capacity on the satellite located at 307 degrees East Longitude, used for North America-Western Europe traffic, is reportedly almost full. A study by NTIA also found significant price competition among the IBS carriers surveyed. (19) IBS customers thus have a wide choice as to price, location and carrier.

In this regard, too, the Commission's decision to authorize private international satellite systems (20) can be credited, at least partially, for the vigor with which INTELSAT has devised new IBS and television services, not to mention new domestic service offerings and configurations. However, while U.S. carriers are no doubt ready to market these services, they remain constrained by the unwillingness of foreign administrations to provide these services at reasonable and attractive prices. The efforts of the U.S. carriers and INTELSAT should over time lead to greater availability of international digital business satellite services.

4.0 FUTURE DIRECTIONS

The FCC has already mapped out several means by which it hopes to instill even more competition in international telecommunications. Its private satellite decision has set the stage for the possible launch of non-INTELSAT satellite systems offering non-switched and television services directly to users and perhaps carriers. The first private satellite system likely to go into service, Pan American Satellite (PanAmSat), is not scheduled for launch until later this year aboard an Ariane rocket. It is far too early, however, to judge whether this policy will be successful, though INTELSAT's reactions have been encouraging. It should be noted, however, that INTELSAT's charges are but a small fraction of the total cost to the user. Significant price and cost reductions need to come from other components of international telecommunication charges.

Additional competition for common carriers could come from the various private cable ventures (21) which have been proposed and/or approved by the FCC. As with private satellites, the potential exists that users could gain direct control of international transmission capacity without the intervention of a carrier by the purchase of capacity from the private undersea cable systems.

The Commission has also, for some time, been attempting to create a new type of competition, which it terms intermodal competition, between common carrier satellite (i.e. INTELSAT) and undersea cable facilities. Until early in the 1980s the Commission mandated how many circuits U.S. carriers placed on satellite and cable facilities. Over time, the FCC has removed loading requirements for all carriers' private line services, since customers often demand either a satellite or cable circuit to meet their specific transmission path and quality needs; from all other IRC circuits; and for all new international carriers. Only loading requirements for AT&T's switched voice services and its 800-service, for example, remain in place in the Pacific. The current loading guidelines will expire in the Pacific in 1991. The Commission has indicated it would like to end or begin phasing out loading requirements at that time. (22)

To phase out such requirements, however, the Commission must first come to grips with AT&T's perceived preference for undersea cables. Part of this preference stems, it is believed, from the Commission's own policy of rate base regulation of AT&T. Under rate base regulation, the amount of a carrier's profit is based on a fixed percentage rate of return on its authorized facility investments. Therefore, the more money invested in facilities by a carrier, the larger the amount, though not the percentage, of its profits. Carriers' preference for undersea cables stems from the fact that only COMSAT invests in the INTELSAT space segment. These and other factors present the Commission with a Gordian knot preventing the institution from intermodal competition. Such competition, of course, would really be between the developers and purveyors of the competing technologies. The goal would be to create an environment in which carriers, not users directly, would choose the most economically efficient technology over which to route their traffic to any given point.

The Commission offered one proposal for untying this knot in the guise of a staff policy paper published one year ago. (23) The paper's authors proposed that the Commission end rate base regulation of COMSAT and AT&T and issue no new loading guidelines for new facilities. Loading requirements on existing facilities would be gradually phased out. The paper drew mostly critical comments from the carriers and only AT&T appeared to cautiously favor many of the paper's recommendations. (24) Nevertheless, former FCC Commissioner Henry Rivera has cautioned the industry to take the proposals in the paper seriously, because they have significant support within the Commission. (25)

Finally, the latest avenue by which the FCC might institute competition and give significant influence and power to users is in earth station ownership. In May 1986, the FCC issued a ruling permitting users to deploy and operate their own receive-only earth station to use with INTELSAT's INTELNET I data distribution service. (26) Just days after the release of that order, Reuters U S Inc. filed a request with the FCC, asking it to rule that users can own and operate transmit/receive antennas, as well. (27) Reuters claimed that the Commission has been wrong in reading the Communications Satellite Act of 1962 as restricting ownership and operation of international earth stations to common carriers. (28)

The Commission has not yet ruled on Reuters' petition. Despite Reuters' contentions, Congress may be required to amend the COMSAT Act before users are permitted to operate their own transmit/receive antennas. Whether foreign administrations will agree to either exchange traffic with a user or permit the user to operate its own transmit/receive facilities in its territory is highly questionable, because to do so would call into question the administration's own legitimacy and rights. In the era of private satellite systems, however, this policy may be a logical means to allow INTELSAT to compete. We can expect developments on this matter to unfold in 1987, in all probability.

5.0 CONCLUSION

The FCC's attempts to institute and encourage competition in order to reduce the costs of international telecommunications and broaden choices for users have had mixed results. Some have attained the results desired and some have not. Some policy initiatives, such as Earth Station Ownership, have had their intended as well as unintended affects which will significantly influence the future of the industry.

There is no denying, however, that the United States today has an increasingly competitive international telecommunications industry in which almost no carrier can claim to have a captive market niche. As a result, according to surveys, international telecommunications users in the United States pay less for almost all types of services, even television exchanges (29), than any other users in the world. Prices continue to fall and choices to expand.

The limiting factor at this point appears largely to be the positions of foreign administrations, who are often reluctant to sign operating agreements with new market entrants or to agree to implement new services. There are signs, of course, that these attitudes are changing, most notably, in the United Kingdom and Japan. It may require, however, users in other countries to increase pressure on their governments to liberalize domestic telecommunications structures before they and American telecommunications users enjoy the full benefits of the policies already implemented by the FCC.

FOOTNOTES

(1) Second Computer Inquiry, Final Decision, 77 Federal Communications Commission Reports, 2nd Series (hereinafter F.C.C.2d), p. 387 (May 2, 1980).

(2) Ibid., Appendix.

(3) GTE Telenet Communications Corporation, Memorandum Opinion and Order, 100 F.C.C.2d, p. 776 (February 22, 1985).

(4) International Communications Policies, Report and Order, 104 F.C.C.2d, p. 208 (May 12, 1986).

(5) National Telecommunications and Information Administration, U.S. International Information Services, Contractor Report 85-32, March 1985.

(6) Record Carrier Competition Act, Public Law 97-130, U.S. Code Congressional and Administrative News, 97th Cong., 1st Sess., 1981, Vol. 1, pp. 1687-91 (codified as Section 222 of the Communications Act of 1934). For background and legislative history, see U.S. Code Congressional and Administrative News, 97th Cong., 1st Sess., 1981, Vol. 3, pp. 2730-40.

(7) Preliminary Audit and Study of Operations of International Carriers, Order, 75 F.C.C.2d, p. 726 (January 29, 1980).

(8) Stuart Sharrock, "Comparative Survey of Telecommunication Costs," Telecommunications, May 1986, pp. 75-76+.

(9) Overseas Communications Services (TAT-4), Report and Order, 92 F.C.C.2d, p. 641 (December 22, 1982).

(10) TRT Telecommunications, Memorandum Opinion and Order, Mimeo No. 4511, released May 13, 1985.

(11) MCI Telecommunications Corp., Memorandum Opinion and Order, Mimeo No. 2570, released February 27, 1984. GTE Spring Communications Corporation, Memorandum Opinion and Order, Mimeo No. 1775, released January 8, 1985.

(12) Stuart Sharrock, "Comparative Survey of Telecommunication Costs," Telecommunications, May 1986, pp. 75-76+. And see, "AT&T Proposes Discounts for International Service," International Communications Week, 21 November 1986, pp. 2-3.

(13) Communications Satellite Corporation Structure, Memorandum Opinion and Order, 99 F.C.C.2d, p. 1040 (December 11, 1984).

(14) Authorized User Policy, Second Report and Order, 100 F.C.C.2d, p. 177 (January 11, 1985).

(15) Direct Access to INTELSAT Facilities, Report and Order, 97 F.C.C.2d, p. 296 (April 25, 1984).

(16) Earth Station Ownership, Report and Order, 100 F.C.C.2d, p. 250 (December 18, 1984).

(17) Statement by former FCC Commissioner Henry Rivera, during "Regulatory Update" panel, Satellite Communications Users Conference, Las Vegas, 9-11 September, 1986.

(18) Data compiled by International Facilities Division, Common Carrier Bureau, Federal Communications Commission, as of November 1986.

(19) Richard J. O'Rorke, Jr., "International Teleports and Their Significant to the U.S.," National Telecommunications and Information Administration, 1986.

(20) Establishment of Satellite Systems Providing International Communications, Report and Order, 101 F.C.C.2d, p. 1046 (September 3, 1985).

(21) Tel-Optik Limited, et al., Memorandum Opinion and Order, 100 F.C.C.2d, p. 1033 (April 5, 1985.)

(22) Authorization of Common Carrier Facilities to Meet Pacific Telecommunications Needs During the Period 1981-1995, Second Report & Order, 102 F.C.C.2d, p. 352 (August 22, 1985).

(23) Evan R. Kwerel and James E. McNally, Jr., "Promoting Competition Between International Telecommunication Cables and Satellites," Federal Communications Commission, Office of Plans and Policy Working Paper 19, January 1986.

(24) "Most Comments Attack Assumptions or Main Recommendations of OPP Paper Calling for End of Rate Regulation of COMSAT, AT&T; ITT Attacks 'Ideological Bias' Toward Free Market," Telecommunications Reports, 17 March 1986, pp. 22-24.

(25) Statement by former FCC Commissioner Henry Rivera, during "Regulatory Update" panel, Satellite Communications Users Conference, Las Vegas, 9-11 September, 1986.

(26) Deregulation of Receive-Only Satellite Earth Stations Operating with the INTELSAT Global Communications Satellite System, Declaratory Ruling, RM No. 4845, Federal Communications Commission, released 19 May 1986.

(27) Reuters U S Inc., Request for Declaratory Ruling (by the Federal Communications Commission), I-S-P-86-006, 22 May 1986.

(28) See Section 201(c)(7) of the Communications Satellite Act of 1962.

(29) "International Users Paying Heavy Premiums for Access to INTELSAT," Satellite Week, 24 November 1986, pp. 3-4.

(30) All data in figures derived from "Trends in International Telecommunications Services," Industry Analysis Division, Common Carrier Bureau, Federal Communications Commission, 13 November 1986.

The Strategic Management of Telecommunications in the Information Age: A Case Study of Three Large Users

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1. Abstract

Innovations in processing and distributing information can lower firms' costs and broaden their range of outputs. It also adds to the complexity and turbulence of an already uncertain world. This paper applies a case study approach to explain the different strategies used by firms to manage telecommunications in the information age.

2. INTRODUCTION

For several decades, scholars have observed the growing importance of information to the economies of advanced industrial nations (1). Information flowing over telecommunication networks is increasingly viewed as the "tranforming resource" of the post-industrial, or information society, like electric power transformed inputs into products in the industrial age. In the economy of the information society, one function of information is as an input that adds value to services and manufactured goods by lowering the costs of production or service provision (2). This in turn may broaden the kinds of outputs a firm can profitably produce.

Scholars have further argued that the marketplace is becoming more complex with the transition to an information society (3). Rapid technological change, growing global competition, competition from firms utilizing telecommunication technologies to enter formerly unrelated markets, greater availability of information about the needs and behaviors of consumers, and changing regulatory policies are among the factors that fuel turbulence in the economy. Organizations in the information society must develop systems to facilitate the rapid acquisition, processing, and distribution of information if they are to survive in the face of such complexity (4).

Consequently, an adequate information technology and telecommunications infrastructure is considered critical for most organizations if they are to remain competitive (5). Managing telecommunications, however, presents a stiff challenge to today's organizations, as the telecommunications marketplace is arguably among the most complex of any area of our economy. Nearly continuous technological change, a vast increase in the number of equipment and service providers, the restructuring of AT&T, and changing regulatory policy all impact on organizations' abilities to manage telecommunications effectively.

This research project uses a case study approach to investigate the range of strategies organizations use to manage telecommunications in the information age (6). The purpose of the study is not only to identify and classify strategies for coping with complexity in the telecommunications marketplace, but also to begin to explain the differences in company strategies. A substantial body of organizational theory provides a rich framework from which explanations of organizational responses can be developed. We begin by briefly reviewing relevant theory, drawing implications for the management of telecommunications. Following this, the study methodology is detailed. Case histories of three large users of telecommunications are then provided, with a subsequent discussion in which we use the theoretical framework to explain variations in management strategies. Finally, we conclude with an agenda for future research.

3. LITERATURE REVIEW

We draw upon several schools of thought from both organizational as well as economic theory in explaining telecommunications management strategies, although space only permits a brief introduction to these areas. One body of literature focuses on the pattern of resource dependency between organizations as an explanation of behavior (7). According to this view, organizations act to reduce dependence on one or a few suppliers of scarce and critical resources. In order to reduce dependence upon telecommunication vendors, organizations will seek to increase in-house expertise, enabling better evaluation of vendor products and services. The creation of a private network to bypass existing vendor facilities, giving organizations maximum control over their telecommunications infrastructure, represents the ultimate action to reduce dependency. On the basis of this approach, we would expect greater development of private networking as a firm becomes more dependent upon telecommunications.

Dependence upon telecommunications results from a number of obvious factors such as the size and geographic dispersion of an organization's operations. However, equally large and dispersed organizations have varying needs for internal coordination and, **therefore**, develop differing telecommunications strategies. Organizational design theorists examine the environment in which a firm is embedded, the nature of the production process, the interdependencies between organizational departments, and the subsequent needs for internal coordination as determinants of organizational communication systems (8). Essentially, these theorists argue that as the environment becomes more complex, and the production process less routine, greater interdependence between units is created. Therefore, a greater amount of information must flow between interdependent units in order to achieve coordination. Thus, greater emphasis on sophisticated telecommunication systems is required in a complex marketplace, particularly when the firm utilizes a nonroutine production process. Organizational structures are also influenced by the pattern of interdependencies across subunits. Strategies ranging from informal communications to formal organizational reporting relationships are used to facilitate coordination. One key interdependency with relevance to telecommunications that fits this model is the relationship of data processing to telecommunications. Clearly, the merging of these two functions occurring in many companies is an attempt to foster greater coordination of facilities.

Using an economic perspective, the above discussion illustrates that the marginal value product of information varies according to the fundamental differences in the organizational structure and production process. Information, although a crucial input for all firms, is more productive for some (e.g. a financial services company), than others (e.g. a shoe company). Perhaps more importantly, once systems for handling complex information processing and distribution needs are in place, economies of scope may allow firms to offer new products or services that "piggyback" on excess capacity. For example, the move by some retail outlets to offer financial services through their existing data networks represents this type of strategic application.

A typology of possible strategic uses of telecommunications is provided by Keen, and reproduced in Table 1 (9). The first strategy, Look for an Edge in Existing Markets, lists tactics that managers can use to improve their positions in their existing markets with telecommunications. The second refers to how telecommunications can improve the internal efficiency of the firm and the third notes how the firm can take advantage of new economies of scope made possible by improved telecommunication systems. Our goal is to help explain why firms choose different strategies from this menu and how even if firms employ the same strategy, their technical and organizational implementations may also differ.

TABLE 1

TELECOMMUNICATION BUSINESS OPPORTUNITIES

I. LOOK FOR AN EDGE IN EXISTING MARKETS
  - Put a terminal in a customer's office
  - Differentiate a standard product through service and information
  - Improve customer access to the firm
  - *Improve the firm's knowledge of the customer needs

II. RUN THE BUSINESS BETTER
  - Manage distributed inventories
  - Link field units to head office
  - Improve internal communications
  - Improve executive information

III. FIND SOURCES OF MARKET INNOVATION
  - Make preemptive strikes
  - Create new services by piggybacking and network interconnection

Source: Adapted from Peter G.W. Keen, Competing In Time, (Cambridge, Mass: Ballinger Publishing Co.), 1986, pp. 36-37.

*Our addition

4. METHODOLOGY

Given the exploratory nature of this research, a case study approach was judged to be the most appropriate to examine, in a preliminary way, the broad-based theoretical models noted above. It is hoped that the insights gained from using this methodology can be applied to a large size empirical study with specific research hypotheses.

Three large Fortune 100 organizations were selected on the basis of industry type and proximity to the researchers. A computer manufacturer, a large retailer, and a chemical manufacturer participated in the study. A series of personal interviews with telecommunications managers and personnel provided the primary data. Five people were interviewed at the retailer, six at the chemical manufacturer, and fifteen at the computer manufacturer. Interviews ranged from 45 to 90 minutes in length and were all conducted by at least one of the authors of this paper. Additionally, information on the facilities and budgets of the firms' telecommunications operations was also, whenever possible, gathered from the firm and secondary sources.

The interview protocol merely set an agenda for the interview. It was designed to direct the respondent to certain areas--and to make sure that certain crucial questions were asked--without unduly restricting the range of topics discussed. The areas addressed in each interview were 1) the individual's job responsibilities and any recent or planned changes; 2) the organization of the individual's unit and the place of that unit within the corporation; 3) the responsibilities of the individual unit; 4) any changes in the function or organization of the unit since 1982; 5) the flow of information within the unit and any changes in that flow since 1982; 6) their thoughts about the impact of divestiture on their job; and 7) forseeable future changes in the functions of their position and unit.

4.1. DESCRIPTION OF THE FIRMS

Company 1

The first case study organization was a large computer manufacturing firm employing over 60,000 people. Its 1986 revenues are projected at 5.5 billion. By 1987 it expects to have 195 employees in telecommunications with a budget of 123 million and 1620 in non-telecom MIS jobs supported by a budget of 140 million. From 1984 to 1987, the firm expects telecom employment to have increased by 44 percent and non-telecom MIS employment to have risen by 8 percent, while total employment in Company 1 will have gone down by about 5 percent. Thus, it seems that the commitment to telecommunications is, at least in respect to employees, on the rise in Company 1. The telecommunications and non-telecom MIS budgets also are expected to rise by some 20 percent and 30 percent, respectively, but, unfortunately, it is not known how these increases stand relative to the total budget increases of the firm. Company 1 owns and operates data and voice networks. The data network, which accounts for about 20-25 percent of the firm's telecom expenses and traffic, sprawls over four continents, has over 70 nodes, and supports over 18,000 terminals for everything from individual communications to nine large daily file transfers. This private network relies almost exclusively on AT&T private lines (56 kbs) for domestic transmission. In fact, the network was set up as a result of a study conducted by AT&T which demonstrated that a consolidated private system would minimize costs. Corporate users are billed according to the amount of data traffic they carry over the course of a year. The costs of both the data and voice networks are covered by users, and not by corporate overhead. The billing for the networks is done by corporate headquarters. The rates are set informally through meetings of telecom managers and personnel with representatives from Company 1's groups.

The voice network was launched in 1983 and can handle most voice services. The network supports over 140 locations, and carries over 760,000 calls adding up to some three million call minutes every month. Recently, because of an increase in private line rates, the costs of the voice network have risen to the point where they are--it was generally acknowledged--close to those charged by some of the long-distance carriers. Since the voice network has a less than sterling reputation for quality--there were complaints of static and disconnects--the increased costs were encouraging some of Company 1's groups to by-pass their own system.

Indeed, the relationship of the corporate telecom department to this firm's divisions and subsidiaries was a cross between that of a utility gamely trying to satisfy the needs of its subscribers and an auditor constantly trying to ensure that telecommunication expenses are kept as low as possible. The divisions and groups are permitted to make minor TC purchases without corporate approval (i.e. phone), but must clear all major items (i.e. PBX) prior to purchasing them. All of their TC accounts are annually scrutinized by a field operations manager from the telecom department at headquarters. Just a few months ago, Company 1 began a new program designed to audit field telecommunication expenses more thoroughly and to devise a way of pricing the services of the private voice network so that it covers its costs, but does not encourage uneconomic bypass.

Earlier this year, Company 1 dramatically re-organized their corporate telecommunications department to, as the general telecom manager put it, "ease the way to a digital world." This was done by integrating all voice and data positions. Thus, whereas before there were separate planners, engineers, technicians, and finance employees for voice and data, those people are now responsible for all telecommunication systems. In previous years, it was felt that organizational snags held up Company 1's ability to exploit new communication technologies--now, with functional integration occuring prior to digitalization the firm hopes to be able to move more quickly in seizing and developing the new production and marketing opportunities created by communication innovations.

For example, Company 1 plans to integrate its voice and data control rooms and to use the new control room to show potential customers the firm's computer manufacturing and networking expertise. Additionally, the firm hopes to develop communication networks that enable it to "leverage" information for marketing purposes more effectively. The long-term goal is to establish an electronic link with customers to respond to their needs with more agility. The short-term goal is to provide sales people with portable terminals that could be linked with the manufacturing data bases to provide customers with more timely service.

Further evidence of Company 1's increased commitment to "leveraging" information is the recent establishment of a unit in the telecommunications department that is responsible for seeking new strategic uses of information and for shortening "the time of introduction of new concepts arrived in Academia." The manager of this unit, brought over from the MIS department, is affiliated with a University program designed to develop new methods of handling and using information.

The firm is also planning to finally set up a global electronic mail system. The new service will piggyback on the data network.

In general, the influence of the telecommunications department seems to have increased in this firm. Members of the department sit on a committee that reviews the production of every product in the firm. Additionally, the telecom general manager sits on a committee with marketing managers to develop methods of bringing telecommunications and marketing closer together. The head of the telecom department also continues to report directly to the MIS vice-president.

Company 2

Our second case study organization is a large, Fortune 100 manufacturing firm, marketing a wide assortment of primarily chemical-based products. With approximately 50,000 employees distributed throughout 112 plants and over a hundred sales offices in the United States and 29 other nations, this company clearly has strong needs for telecommunications. The telecommunications function was organized in 1979 into a corporate Information Systems and Communications Services department, with both global and U.S. responsibility. The corporate telecommunications staff numbers well over a hundred people, with each major plant division employing their own telecommunications staff.

The telecommunications network at Company 2 is large and complex. Before 1979, the company generally relied on AT&T WATS lines and Centrex services to handle their telecommunications requirements. In 1982, a satellite-based bypass network was installed for corporate needs, first for voice, and later for data requirements. Due to complaints about satellite delay, this network was phased out for voice, but is still used for data traffic. Presently, the company relies primarily on a mix of AT&T and MCI leased lines, and has installed about 30 digital PBX's for local switching. In office locations, the company has invested heavily in broadband local area networks (LANs), linking terminals and personal computers with several hundred IBM and DEC mainframes. These include X.25 interfaces to public packet switched networks that enable data communications with overseas locations. Through leased 56K lines and the satellite network, the company has moved from an entirely batch, dialup data network to a private global data network. A large electronic mail system is in place, and the implementation of voice mail has just begun. Attempts to implement full motion and freeze frame teleconferencing have been unsuccessful in the past, although employees frequently engage in audio conferences.

In plant locations, the very specialized requirements of continuous process production dictates the nature of the telecommunications network. The largest plant division has their own private network, utilizing microwave to monitor pipelines remotely, and fiber optic lines to connect plant locations for telephone and data traffic. An Intecomm switch provides digital switching, enabling voice and data transmission from the same ports. In addition, broadband cable is used for video for surveillance and security pruposes, data transmission, video monitoring of process areas, and distribution of video training tapes.

Prior to 1979, voice, data, and video communications all operated in separate units. Moreover, telecommunications was handled by each area, rather than at the corporate level. Beginning in 1979, a global corporate telecommunications function was created, and voice operations were merged into the data processing department. The new Information Systems and Communications Services department (ISCS) is subdivided into various voice and data subunits. Each area division maintains their own telecommunications staff, but these individuals have a dotted line reporting relationship with the corporate telecommunications director. The head of ISCS reports directly to a senior vice president, who also sits on the board of directors. Video communications has no connection to the corporate telecommunications function, and is housed in a separate audio-visual department.

The corporate telecommunications staff provides voice and data service out to all the field offices and small plants, and deals extensively with the field marketing personnel. The department operates much like a utility, charging other units for service.

Company 2 sees continued use of bypass facilities, hoping that their choice of IBM, MCI, and Rolm will result in synergy through future integration of product lines. Senior management envisions greater use of their existing network as an information resource. Future plans include an expansion of LAN facilities, development of a custom tailored workstation that will handle protocol conversions for users, and centralization of process control information to enable better inventory management (e.g. waste from one plant might be feedstock for another). The company is quite concerned about standardization of their telecommunications systems, and hopes to utilize their systems strategically through electronic data interchange (EDI) activities. With EDI, customers can access the company databases electronically for remote ordering. In the long term, the possibility of customer database to company database links are foreseen, enabling, for example, automatic detection of low inventory at the customer site, immediate ordering, and subsequent production planning, billing, etc.

Organizationally, the company envisions further integration of voice and data personnel to increase communication on joint project work and enable control over equipment selection to ensure integration of facilities. They see a need for more qualified personnel, and they engage in a large amount of inhouse training. One particularly interesting feature of the organizational structure is the position of senior consultant. This individual reports directly to the corporate director of ISCS, and works with all divisions in the company to help plan for future telecommunication systems and services. He serves primarily as an internal consultant, troubleshooting when problems arise and encouraging various units to take advantage of new technologies. Moreover, he stays abreast of new developments by participating frequently in outside seminars, and representing the company's interests on national and international standards-making bodies.

Company 3

The third firm chosen for this study is a large discount retailer. Company 3 has a large corporate headquarters complex, 6 regional offices, 10 distribution centers, 2,100 retailing outlets, and various subsidiaries across the country and overseas. The firm generated over 22 billion dollars in revenues for fiscal year 1985 and employed more than 250,000 individuals worldwide. As of 1986, 776 employees at headquarters were in non-telecom MIS jobs, and 39 people were working directly in corporate telecommunications.

Unlike the other firms, this corporation has no plans to integrate its voice and data operations. Indeed, telecommunications seems to receive a lower level concern at this firm than the others.

At this time, the stores' voice needs are handled by the individual stores and corporate headquarters. The stores are given a great deal of autonomy in its general operations as well as in telecommunications; they have to receive approval only for large telecommunication expenses. Since there is very little voice traffic between the stores themselves and between headquarters, there is no pressing need for centralization of the firm's voice functions. The stores usually funnel all their voice traffic through simple key systems, which makes this firm the second largest key system user in the country.

Headquarters uses a combination of PBXs and Centrex services which facilitate call forwarding, station message detail reporting (SMDR), and other options. Corporate voice needs are monitored and met by a staff of six people; the chief voice analyst reports directly to the vice-president for MIS.

The data side of Company 3's operations is controlled by a separate corporate communications support group which also reports to the MIS vice-president. The firm currently leases 30 to 40 private data lines from AT&T, MCI, and Spring to form the backbone of a data network. The network transmissions include information on credit authorization--Company 3 is the largest credit authorizer in the world--pharmacy payments, insurance claims, and point-of-sales (POS) data. The store terminals attached to the network are managed by the corporate data group.

Company 3 plans on setting up a private satellite packet-switching network using VSAT (Very Small Aperture Terminals) technology. Apparently, the first plans for this system were developed in 1979, making this a very slow transition. Presently, the system's design and implementation is being monitored by a five person staff in the corporate support group.

VSATs will be placed at headquarters, the stores, the distribution centers, and the regional centers. The satellite station will be linked with other locations by ground links. The completion of the VSAT project is scheduled in 1990. The system is designed to handle the current large daily file transfers as well as other new information processing and distributing tasks. It has been estimated that the firm will save between $4 million to $5 million per year with the satellite network.

This company also believes that the extra capacity on the VSAT system will make it possible to profitably offer new services. Following a current industry trend, this discount retailing firm has expanded its operation into financial services. As of January 1986, insurance centers operated in 173 of its stores which are connected by an automatic call distribution system. Those centers market life, health and property/casualty insurance. In addition, the firm launched several pilot programs to provide financial services through savings and loan operations offering certificate deposits, money market shares, IRA accounts, and automatic teller machines in some stores. Real estate brokerage, consumer loans and mortgage banking services are also offered in selected stores. For these new business applications, improved information distribution through VSATs will be playing an indispensable role as a strategic marketing weapon.

5. DISCUSSION

Based upon the case histories, a markedly different approach to telecommunications is evident in each of the three companies. The theoretical formulations introduced earlier can help make sense out of the strategies employed by each firm, and begin to provide a framework for a broader understanding of the telecommunications management function in large user organizations. In this section, we use economic and organizational theories to interpret and begin to generalize from the patterns of strategic uses found.

5.1. STRATEGIC USES OF TELECOMMUNICATIONS

In a highly subjective fashion, we compare each of the three firms in terms of the strategic uses of telecommunications uncovered in the interviews. Table 2 presents the relative commitment of each firm to the various strategies in Keen's typology, with an entry of 1 for strong commitment, 2 for moderate commitment, and 3 for little commitment. The ratings reflect our interpretation of interviewees' comments, rather than responses to direct questions, and as such may overlook some activities of each company. However, a general pattern emerges that is interpretable, and we tentatively try to explain differences below.

All three companies seem to be committed to use of their current and developing telecommunications infrastructure to improve the efficiency of internal operations. That is, such uses as managing distributed inventories, linking field units to head offices, and improving executive information were objectives discussed by interviewees in each company. Such applications make sense regardless of type of business, and are quite critical to organizational survival in the complex environment portrayed by the information society theorists.

TABLE 2

STRATEGIC USES OF TELECOMMUNICATIONS BY THE EXAMINED FIRMS

	COMPANY 1 (computers)	COMPANY 2 (chemicals)	COMPANY 3 (retailer)
I. AN EDGE IN EXISTING MARKETS			
-Put a terminal in a customer's office	1	1	3
-Differentiate a standard product through service and information	1	2	2
-Improve customer access to the firm	1	1	3
-Improve the firm's knowledge of its customers' needs	1	1	3
II. RUN THE BUSINESS BETTER			
-Manage distributed inventories	1	1	1
-Link field units to head office	1	1	1
-Improve internal communications	2	1	3
-Improve executive information	1	1	1
III. MARKET INNOVATION			
-Make preemptive strikes	?	?	?
-Create new services by piggybacking and network interconnection	1	3	1

On the other hand, there appears to be some differentiation with regard to efforts to improve internal communications. By this, Keen is referring to the use of telecommunications to promote more timely person-to-person interaction. Various forms of teleconferencing, voice mail, and electronic mail are examples of such uses of the telecommunications infrastructure. In this category, the chemical company seemed to be the most active. They experimented albeit unsuccessfully with full motion and freeze frame video conferencing, and currently use audio conferencing. An interpersonal electronic mail system is up and operating, and voice mail is currently being introduced.
The computer firm is rated as moderately committed to this application area, as they, too, experimented with audiographic types of teleconferencing, and hope to introduce an electronic mail capability. However, their efforts concentrate more on improving individual access to database information, rather than improving person-to-person communications. The retail firm was virtually inactive in this area, with only a voice mail system available to employees at corporate headquarters. Enhancing personal interaction with field units was not viewed as necessary, given the nature of their business.

The organizational design literature would anticipate this type of pattern, given the nature of interdependence between subunits in each company. That is, the complexities of continuous process production (the chemical firm) and the somewhat customized production of large computer systems would require greater internal coordination. In the chemical company, for example, one plant's products may be another's feedstock, necessitating precise coordination through information exchange. Likewise the manufacture of computers requires interaction of marketing (to provide customer needs), manufacturing, and software production. On the other hand, the various field units in the retail firm operate autonomously in a form of pooled interdependence. One store's actions are virtually independent of another's, with the exception that overall profits affect the resources available to all.

Even greater differentiation in strategy is seen in the other areas of Table 2. Information does not function equally across all three firms as an input that adds value to existing products. The computer and chemical firm both employ or plan to employ their telecommunications infrastructure to gain an edge in existing markets. In the computer firm case, the company hopes to use its network to sell more computers in a number of ways. These uses range from providing terminals to sales people all the way to linking the customer to the framework to enable remote servicing of computers when possible. For the chemical firm, providing customers with a terminal for more timely product ordering would help to give them a competitive edge, both in terms of customer ease and their own production scheduling. These kinds of applications are less significant in the retail company, where stores operate independently and no goods are produced per se. Merchandise is standardized and offered at the retail store location. For one product, however, the retail firm hoped to gain an edge by using their coming VSAT system. They felt that in the marketing of prescription drugs, customer convenience would be increased if all retail outlets had access to customer prescription records. Thus, a customer could obtain refills at any store, adding value during trips, for example.

Finally, two of the three firms envisioned being able to offer new services by piggybacking onto the telecommunications network. In each case, economies of scope existed, enabling companies to take advantage of existing expertise, sunk costs, or key relationships with an existing product line in order to offer a new product or service at a lower cost. The computer firm hopes to market turnkey network control centers. Their development of their own network control center provided needed experience. Moreover, their control center ran on their own computer products. Finally, they planned to use their control center as a marketing tool by making it a showcase for their product line. In the retail firm, their investment in a data communications network made possible experiments with the provision of financial services. This type of service requires a market presence in many locations as well as rapid data transmission capability.

5.2. IMPLEMENTING ORGANIZATIONAL TELECOMMUNICATIONS STRATEGY

Just as the three companies engage in different strategic uses, the organizational structures and processes for managing telecommunications vary from firm to firm in interpretable ways.

Three ways in which firms might approach telecommunications are described by Keen (10). In the predivestiture days, most common was an operations approach to telecommunications, with an emphasis on providing a reliable service. Most technical matters were handled by the telephone company, and the telecommunications function was little more than an administrative unit. Voice and data operations were handled by distinct units. In the early 1980's, faced with escalating costs, and increasing complexity in the telecommunications operation, most large firms developed a consolidated corporate unit to handle both voice and data operations. The emphasis was on providing services and controlling costs. Often, these units operated as an internal utility, even to the point of charging costs to users in the company. According to Keen's perspective, firms that advance beyond this second utility stage treat telecommunications as a coordinated business resource. Although controlling costs is still important, the emphasis is on providing an infrastructure that facilitates strategic applications. Telecommunications then becomes a business function, rather than an operations and administrative unit.

Both the computer and chemical company clearly progressed into the utility stage several years ago with the development of their private voice and data networks. The retail firm is moving in this direction with their data communications network, but remains fixed in the operations stage with voice services. Again, the nature of interdependence between organizational units explains the varying needs, and subsequent organization strategies of these entities. In large part, the complex production process created a key dependence upon telecommunications for effective organizational coordination. Using the resource dependence perspective outlined earlier, this would explain why these firms created private bypass facilities before the AT&T divestiture. It may be that the desire for control over a critical resource was deemed necessary in a market dominated by one supplier. Thus, with emerging competition acting in part to constrain the dominant suppliers, many firms with private networks are encouraged to return to leasing public facilities.

Using an organizational structure perspective, the organizational design literature postulates that structures must allow interdependent units to exchange information for effective coordination. Many companies, for example, have responded to interdependencies between voice and data operations by merging data processing and voice personnel into a common unit. The strategic application of telecommunications requires interaction between telecommunications and other business-oriented units, however. Varying degrees of integration between voice and data operations, between telecommunications and production operations, and between telecommunications and marketing operations were found in each of the three companies. A summary of our subjective ratings of these types of organizational strategies appears in Table 3.

TABLE 3

ORGANIZING STRATEGIES IN THE THREE FIRMS

	Company 1 (computer)	Company 2 (chemical)	Company 3 (retail)
Integration of voice and data operations	1	2	3
Integration of telecommunications and production operations	1	1	3
Integration of telecommunications and marketing/business operations	1	2	3
Creating of an organizational change agent	1	2	3

Once again, the firms with greater information and communication requirements appear to more fully integrate their telecommunications operations with other areas. The computer firm has arguably the most complex product line, and is the most active in applying their network and telecommunications expertise strategically. (Of course, the often noted convergence of computing and telecommunications contributes to their need to integrate telecommunications with their computer products.) Thus they are rated as most strongly committed to all three types of integration. Their functional integration of voice and data--making the same individuals responsible for both voice and data activities--exceeded the integration possible when organizational units are merged but personnel maintain their old functional differences. Interestingly, the retail firms lack of a need for integration resulted in the separating out of voice operations from the data network group. Finally, as described in the case studies, the computer firm also involved telecommunications personnel in product planning and marketing activities. This type of integration is by far the most critical in developing strategic applications for the telecommunications infrastructure.

Another structural feature noted in Table 3 that seems critical to the promotion of strategic applications is the creation of a formal organizational position we call a change agent. Implementing new telecommunications systems and services represents an organizational change that requires an internal advocate. The computer firm operates in an industry characterized by rapid technological change, and so must innovate often to stay competitive. Strategic uses of telecommunications can facilitate such innovation, explaining the formal creation of an advocate who was in a position to be exposed to new ideas and searched for new application areas within the company. A similar person existed in the chemical firm, although the job functions were not formally stated. Without much of a dependence upon their telecommunications infrastructure for survival, the retail firm did not have a formal change agent, although one person clearly functioned as the advocate for the VSAT data network.

TOWARDS A RESEARCH AGENDA

The exploratory method used here helped to generate a number of insights into the process of telecommunications management. By relying on organizational and economic theories, management strategies were found to be clearly interpretable and related to key aspects of an organization's structure and environment. It is now necessary to undertake a more formal and systematic investigation of the management of telecommunications. Clearly, such a study should incorporate a larger number and more varied set of organizations in the sample, with multiple representatives of each industry sector. In addition, a more standardized data collection strategy is necessary, enabling quantification of the key relationships that we have begun to identify in this study. Finally, our approach has been primarily descriptive rather than prescriptive. In the next phase of this research program, strategies of organizations in competing industries must be compared to some measure of performance. While partialling out alternative explanations for organization performance is virtually impossible, some attempt to relate the strategic application of telecommunications to key performance indicators is desirable.

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THE GLOBAL ASPECTS OF ISDN

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1. ABSTRACT

The promise of ISDN is exciting. But before there can be widespread implementation of ISDN there must be an evolution from concept to affordable, useful products and services. Satellites offer some real advantages over other media in ensuring that users throughout the world can fully benefit from the ISDN concept. Specifically, INTELSAT offers a full array of ISDN-compatible services today, and will continue to develop more in the near future.

2. INTRODUCTION

The Integrated Services Digital Network. ISDN. In an era when acronyms are ubiquitous, perhaps no other string of letters can elicit such a dramatic response from listeners and readers throughout the world. Mention of ISDN seemingly leads to eyes watering and hearts beating faster at the prospect of participating in this dramatic and comprehensive evolution from today's analog, segregated, narrow bandwidth networks to a truly global, digital, integrated broadband network.

The promise of ISDN is certainly alluring. It brings the expectation of true end-to-end broadband communication links with ready access for transmission of data, voice, and even video for people everywhere. During the next few minutes I am going to describe in some detail the service offerings of the only global telecommunications network capable of providing ISDN-compatible services today -- INTELSAT.

But before I do, let me take a moment to emphasize a contextual point which I would like you to keep in mind as you hear more about ISDN today and as you consider your organization's participation in this obviously very exciting phenomenon. And that point is to remember that the ultimate catalyst influencing how quickly ISDN becomes integrated into the world's telecommunications web will be the user. ISDN will thrive only when it is translated from a concept into products and services.

There is certainly no argument with the concept, articulated by AT&T as "a graceful evolution of today's telecommunications networks towards a powerful, unified, network fabric featuring universal ports, dynamic allocation of bandwidth and other resources and adaptive, logically provided services." But remember, customers don't buy concepts; users don't use concepts.

In the past few years there have been some dramatic, if ultimately misplaced direction signposts for telecommunications, erected by talented but misguided technocrats who ignored the basic motivation of potential user requirements--need, perceived volume, simplicity, and cost. Allow me to remind you of a few of them, not as analogies to ISDN, but simply as examples of concepts that did not translate into services or products for a variety of reasons and thus failed to achieve the high expectations placed upon them by many.

Remember "picturephone" in the 1960s? Who wouldn't have expected "eyeball-to-eyeball" tranceivers to be the logical next generation of telephone service? Who could afford it? Some hundreds of millions dollars later, not even AT&T, and the service was discontinued.

In the mid-1970s, videoconferencing was touted as a major substitute for business travel, and the economic calculations proved it. What was overlooked was the side and personal benefits of business travel, and perhaps the temporary end to the oil crisis. Videoconferencing will continue to exhibit healthy growth, but as an adjunct, not a substitute for business travel.

Videotex was going to provide almost universal information access for residential and business customers, with home shopping, banking, travel-booking, and education thrown in. A couple of years ago, the majority of British Telecom's Prestel computers were put into mothballs and the system has largely been reoriented largely towards specialized business user groups.

Now, I realize I've run a certain risk pointing out the "dark side" of telecommunications service development at the start of my presentation. I certainly do not mean to give the impression that I am a luddite, one who fears technological development, as an ideology. As a representative of the world's leading success story in international cooperation and provider of the ultimate "high" technology, I honestly believe that sooner or later, in one form or another, the concept of ISDN will be translated into myriad of exciting and useful services and products for everyone in this room.

But until then, (and for some telecommunications users, especially those in the developing countries, it will be sometime before they will be exposed to some of the inherent advantages that ISDN can bring) I would encourage all users to be relatively hard-nosed about ISDN. Do not be swayed by grandiose claims about a concept. Ask how, when, and at what cost can ISDN be of use to you in catering to your everyday telecommunications needs of today, and in your planning for tomorrow.

Ladies and Gentlemen, INTELSAT is providing ISDN-compatible services, on a global basis -- today Not five years from now. Today. While terrestrially-based networks are feverishly adding fiber-optic capacity for ISDN services, INTELSAT has the capacity in place. And everyone can access it.

We provide a range of ISDN-compatible services to meet user requirements in both public and private networks. The INTELSAT network is dynamic, flexible, and pervasive. It provides global interconnectivity and access virtually from anywhere in the world. Its nearly 170 users have requirements for digital services, analog services, ISDN services, and non-ISDN services. We have responded successfully to all of their needs by providing a spectrum of service options from which users may choose in configuring their networks.

Because of its flexibility and scope, INTELSAT will have a major role to play in worldwide implementation of ISDN. The INTELSAT network is a critical element in providing the interface between analog and ISDN networks and maintaining global interconnectivity. For many developing countries, INTELSAT will be the only means of providing an international ISDN capability. We plan to continue and expand our high quality, reliable, cost effective ISDN service offerings and ensure that ISDN is universally accessible for users now and in the future.

3. SATELLITE AND FIBER OPTIC CABLES IN AN ISDN ENVIRONMENT

Let me now touch on a subject that seems to be of great interest to many--i.e., the relative merits of satellites versus fiber optics in an ISDN environment.

Satellites have a number of advantages over fiber optic submarine cables in providing a range of international services in general and ISDN services in particular. This may be a surprising revelation for some of you since there are a number of myths circulating about the capabilities of satellites.

Myth #1: Fiber optic submarine cables are cheaper than satellites and can provide international ISDN services more cost effectively.

Reality: Global implementation of ISDN will require massive investment in new facilities. Projected investment in ISDN telecommunications capabilities on a global basis could ultimately total several trillions of dollars. This massive investment, despite efficiency gains, could result in telecommunications services being offered at higher rather than lower rates. In fact, estimates of ISDN cost and resultant digital services tariffs in just one country suggest that enhanced digital telephone service might cost substantially more than its conventional services today.

The level of investment required to implement full-network ISDN means that ISDN will not be cheap. Many users will benefit dramatically from the features of a true ISDN network and will be willing to pay for them. There will be many users, however, who will have requirements more suited to satellites and who may desire less conservative link budgets at lower tariffs. For these users the advantages of an end-to-end satellite network, providing complete control over the entire link and the ability to send a variety of transmission speeds to a large number of nodes, represent the real benefits of an all digital telecommunications network, especially when significant cost savings are likely.

INTELSAT will continue to be a cost effective provider of ISDN and other digital services in the era of TAT-8. INTELSAT undertook a detailed economic comparison of the relative cost efficiency of an INTELSAT VI satellite operating in a heavy-route trunking mode versus a TAT-8 fiber optic undersea cable. This detailed comparison showed that the digital throughput rate of an INTELSAT VI is 3.6 times faster than TAT-8. This study also made several conservative assumptions for earth station costs and for satellite operating and capital costs. We assumed only a 10 year lifetime for INTELSAT VI, even though we anticipate a 14 year life. Despite our conservative assumptions, we still found that the cost of a telephone circuit year on an INTELSAT VI would be three times less than on TAT-8. With less conservative assumptions, a 4-to-1 cost/benefit ratio could be demonstrated. And, of course, if what's been commonly labelled the "COMSAT maneuver" is employed the ratio would only be more dramatically in favor of satellites.

Myth #2: Fiber optic submarine cables can provide ISDN services more reliably than satellites.

Reality: The INTELSAT system is the most reliable system in the world, consistently achieving more than 99.9% continuity in its space segment and earth station operations. We have consistently restored service interrupted on undersea cables and are planning to continue to do so in the era of TAT-8. We offer a restoration service of eight (of 48) transponders of a single INTELSAT VI satellite for the fully loaded traffic of TAT-8. We have also introduced other new services applicable to heavy-route digital trunking. With INTELSAT V, V-A, and VI satellites and use of digital modulation, low-rate encoding, and digital speech interpolation, INTELSAT will have an effective in-orbit capability of over one million telephone circuits. While the recent spate of unfortunate launch vehicle failures may be viewed by some as impacting adversely on satellite service reliability, INTELSAT operations have not been and will not be impaired. Our system is planned and designed with sufficient redundancy to address these contingency situations.

Myth #3: Time delay/echo is a key vulnerability of satellites in comparison with terrestrial media (especially fiber optics).

Reality: This is a widely held but essentially inaccurate perception. Echo is a completely solvable problem; pure delay represents fundamental physical constraints, the speed of light. Progress in the elimination of echo has been substantial, to the point that modern echo cancellors can eliminate any practical limitations. AT&T conducted a number of tests in the late 1970s to test user reaction to satellite delivered voice service. Nearly 10,000 customer interviews were included. A similar study was conducted in Canada by the Trans Canada Telephone System and Bell Northern Research over actual satellite networks. The results of both of these studies showed that a satellite circuit equipped with echo cancellors is indistinguishable from a long haul terrestrial circuit equipped with a suppressor in terms of customer rating.

For data, the possible limitations imposed by a transmission delay are measure in terms of loss of throughput. This is affected by the data rates and protocols used for error control. In general, indiscriminate application of terrestrially oriented protocols to satellite links will lead to unacceptable performance. However, suitable techniques can be employed to overcome these problems. With use of such delay compensation techniques and protocols, satellite throughput efficiencies equivalent to those of terrestrial links can be obtained, and a satisfactory response time can be achieved.

Given these considerations, why have these myths evolved? Perhaps the explanation may be found in the fact that, to date, leaders in ISDN implementation have tended to define ISDN service with some considerable bias in favor of national terrestrial communications systems. Thus, they have ignored the advantages of satellite communications systems. Because fiber optic cables are basically only point-to-point facilities, they are perceived as more controllable than satellites. Because major planners in the ISDN arena to view ISDN as a means of tying the end-user more closely to their products and services, fiber optics are considered to be inherently a better medium. ISDN is evolving from telephony IDN which is, in turn, an outgrowth of the PTSN. Thus, the network is seen primarily only in terrestrial terms, with satellites viewed as an inadequate substitute for long distance point-to-point transmission.

4. INTELSAT AND ISDN

The INTELSAT global satellite system currently carries approximately two-thirds of all international phone calls and virtually all the international television transmissions. Domestically, the INTELSAT system has also enabled growth in telecommunications infrastructure and services in many countries; presently INTELSAT is providing domestic service for 27 countries.

What role will satellites play in the ISDN environment of tomorrow? How will the variety of flexible network and service features of satellites be incorporated within ISDN to realize the inherent advantages and full potential of this technology?

INTELSAT provides a wide range of digital services, both ISDN and non-ISDN compatible. INTELSAT's Time Division Multiple Access (TDMA), Intermediate Data Rate (IDR), and Super INTELSAT Business Service (Super IBS) offerings have made the first ISDN services easily obtainable at the international level. We are continuously evaluating ways to expand these services and offer them at even more attractive rates. At the most recent INTELSAT Board of Governors Meeting (held last month in Washington), substantial reductions of up to 30 percent in digital services tariff rates were considered, based upon a five-year service commitment.

There are several unique features of satellites in an ISDN environment--flexibility, low-cost, global reach, mature technology. It is well recognized that rigidly hierarchical networks based on terrestrial transmission systems are not always optimum from the point of view of the user or the network provider. The telecommunications networks of tomorrow will be truly three-dimensional, extending up to 22,300 miles above the world's surface, with access to any point possible via communications satellites.

At INTELSAT, the basic infrastructure for ISDN is in place now. Three new digital services currently being offered meet a number of ISDN specifications, and allow users with certain telecommunications needs to begin reaping the benefits of digital telecommunications today, years before ISDN will be fully implemented.

A. TDMA

Three TDMA networks are presently in operation on INTELSAT V satellites, two in the Atlantic Ocean Region and one in the Indian Ocean Region. These networks carry a total of 2,800 two-way telephone circuits and 20 traffic terminals between them. In the TDMA system, the transmission of traffic takes place by time-shared use of the entire bandwidth of the transponder by users in a time-sequential manner. The traffic is transmitted in high-speed (120 Mbps) burst mode over time by repetition of a systematic pattern of a basic time unit called a TDMA frame under proper synchronization. The use of TDMA can provide improved system flexibility with increased satellite efficiency and is the ideal medium for digital interfacing from digital terrestrial networks and ISDN systems.

The present INTELSAT TDMA system (120 Mbps) provides full compatibility with ISDN requirements in regard to availability (worst month: 99.8%) and bit error rate (BER=10^{-7}). This applies to both digital speech interpolation (DSI) and digital non-interpolation (DNI) channels.

Introduction of satellites switched TDMA (SS/TDMA) on INTELSAT VI will enhance the flexibility of the system and enable traffic to be routed through any inter-beam connection on a time division basis. The change of traffic routes between uplink and downlink beams can be done according to need by alteration of the burst time plan.

B. IDR

Digital transmission of carriers up to data rates of 2.048 Mbps was introduced in 1978. In 1984, as demand for this type of service grew, detailed transmission parameters were developed and the phrase "Intermediate Data Rate (IDR)" digital carrier was coined. The word "intermediate" was used because these transmissions were intended to fill the gap between pre-assigned SCPC (maximum information rate of 56 Kbps) and TDMA (120 Mbps). Today, IDR carriers are approved for carrying information rates ranging from 64 Kbps to 44.736 Mbps.

IDR carriers are intended to be the digital equivalent of the FDM/FM network and are expected in the future to replace FDM/FM as the backbone of the INTELSAT system. There have been recent decisions to extend IDR service to smaller earth stations in the Standard E-3 and F-3 classes, and action on the Standard E-2 and F-2 (5-8 meter) earth stations is expected soon. This makes possible affordable new international gateways for $200K to $300K (U.S.).

In practice, the IDR transmission mode may be utilized in a variety of service applications, including digital telephony and digital television. For digital TV, depending on the specific signal processing, coding schemes and quality objectives, transmission bit bites in the order of 15, 30, 45 Mbps may be used, and this type of transmission requirement fits in perfectly with the IDR system. Further, the expected rapid growth in the use of the primary rate ISDN interference groups [23B & D (1.544 Kbps) or 30B & D (2.048 Kbps)] is conducive to the INTELSAT IDR system. IDR services are designed to meet CCIR quality objectives for both PCM voice and ISDN connections. IDR performance specifications are presently being modified to include the use of forward error condition (FEC) that would allow compatibility with the ISDN.

C. IBS

INTELSAT Business Service is a totally integrated service designed to permit provision of a full range of business service applications while retaining the flexibility to evolve through the incorporation of technical and service improvements as they are identified.

IBS users may operate in either a closed or an open network. In the closed network, the user is expected to design his system around his own specifications and must ensure his own network compatibility. In the open network, a more detailed set of standards are provided so that users can avoid the need for bilateral or multilateral negotiations. In either case, the clear sky BER is of ISDN quality (10^{-7}), but the system availability (99%) is worse than ISDN quality. A "Super IBS" will be offered soon to provide higher availability for those users who require it. However, IBS (as presently defined) cannot be connected to the public-switched network.

Aside from the availability issue, the compatibility of the open network with ISDN is currently being investigated. Nothing prevents ISDN traffic from being carried on the open network and ultimately users could employ ISDN equipment on the IBS open network, and use IBS as a "private ISDN" from an equipment point of view. In addition, included in the IBS open network specification is a section on satellite delay compensation to insure compatibility of the protocols with the satellite environment.

It is worth noting, and is perhaps not too surprising, that the most rapid rate of growth for IBS is the next few years is expected to be in the Pacific Ocean Region. The most recent projection show a reasonable growth from 40, 64 Kbps equivalent channels in 1986 to over a thousand by 1990. Indeed, at a time when many carriers are faced with the problem of oversupply, and we fall in that category for some of our services, our biggest problem in IBS and other digital services, is keeping up with demand.

We've recently reshuffled some of our traffic to allow for rapid future growth in our digital services, but will breathe a little easier when the INTELSAT VI's come on-line in a couple of years.

5. CONCLUSION

We are now at a point of transition in telecommunications, between a largely analog world and an advanced digital communications world, between the need for hierarchical point-to-point telecommunications networks and dynamic, flexible, customer-premise non-hierarchical networks.

ISDN is coming. The variety of interests present, here, today--manufacturers, service providers, policy makers, etc.--is testimony to the excitement and commitment that ISDN has generated in the past few years.

Ultimately, it will be the user who will decide how ISDN evolves and what form it takes, just as it was the user who was responsible for the seemingly quick success of the new cellular radio service, and whose disinterest spelled failure for most videotex services.

Many users will be quick to embrace the dramatic merits of ISDN. Many won't. The point is that all users will continue to acquire the most appropriate equipment and services for their specific requirements.

By the use of more powerful satellite transmitters, particularly on our modified INTELSAT VI satellites, and the concomitant growth of smaller earth stations at cutomer-premise or local gateways, satellites offer the advantages of distributed traffic in flexible network configurations.

INTELSAT will continue to develop new services that offer the main advantages of the ISDN, either in a fully compatible mode, or in partially compatible configuration with reduced costs. With its unique capacity to offer both narrow-band and wideband services to an infinite number of nodes in a non-hierarchical network, and the ability to offer a truly global reach, INTELSAT will play a major role in the shaping of ISDN, and even more importantly, as provider of these valuable services to telecommunication users throughout the world.

SESSION 2
User Perspectives

How to Meet the Diversifying User's Requirements

--- A Strategy for the Provision of New Telecommunication Services ---

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1. Abstract

User's requirements for telecommunications services may change seeking optimum features and cost reflecting the inovation of technologies. Several approaches will be conceived when new telecommunication services are planned and implemented in such circumstances as the market forecasts for user's demand are uncertain. Two extreme approaches, named "specialty shop" and "department store", are discussed and followed by a case study of various international facsimile transmission services which KDD has provided or planned.

2. Two different approaches to the provision of new services

2.1 Two extreme approaches

There are several approaches to meet versatile requirements of users when new telecommunication services are planned and implemented. The reason why there are several ones is that there are alternatives in the selection of data transfer networks and terminals reflecting the rapid inovation of technologies in the field of telecommunication and processors. There are also alternatives in the combination of networks and terminals to satisfy one requirement of users.

The most significant concern of telecommunication carriers might be which alternative(s) they should choose when they provide new telecommunication services the market size of which are uncertain.

Two extremes among these alternatives maybe "Specialty shop" and "Department store" approaches. In a specialty shop, users are able to buy only a single service tailered to a predetermined specific model. In a department store on the contrary, they are allowed to enjoy selecting a service out of many considering their own, each specific requirements. These two approaches will be discussed in this section.

2.2 Specialty shop approach

It is considered in the specialty shop approach that a single telecommunication service is provided to aim at an average requirement of users. In this approach, a model of users' requirement is assumed to represent ones of all users, and consequently the requirements of many users are satisfied nominally on the average alone. Many users will be obliged to adjust themselves to the average model.

One feature of this approach, however, is the service level of it will be kept to the one expected because the service will be so designed as to suit one predetermined model. The cost of the service, and then the charge of it, will be maintained rather cheap as far as the number of users is as forecasted.

Otherwise, when there are less users than expected, the investment to the service will be identified as excessive and the life of the service may have to be ended earlier.

The history of telecommunications may, perhaps, have shown that most PTTs or carriers have tried to provide a single service, e.g., telephone, following the specialty shop approach without knowing it of course, just because the most important mission of them might have been to spread the service economically throughout the country.

The situation is different at present in some or many countries. The effectiveness of a service is pursued to the extent that a specific application is met at the optimum cost. In this case, a user may find a service he wants in a specialty shop as in the last resort. That is, he cannot but use it when he cannot find just what he wants in any other place.

2.3 Department store approach

It is considered in the department store approach that multiple telecommunication services are provided to meet versatile requirements of users, who can select a service out of many consulting their own specific applications or budgetary restrictions.

Many goods are sometimes found to be left unsold in the showcase of the department store. These goods are put in it for various purposes, the first one of which is undoutedly to sell them. However, there might be other ones in many cases.

The second possible purpose will be to survey the trend of the market, i.e., to know directly the consumers' mind for the planning of products. A rather new word "antenna shop" represents the function of this case. It is very important for the executives of trading corporations or manufacturing works to know the trend of market prior to their decision of big investments on new products. One of the effective approaches to know the trend is to use "antenna shop".

The third one will be a "full line" policy of a department store where customers expect to find any goods they want to buy or just to look at. In this case, some goods in the showcase solely exist to be looked upon and perhaps to promote the sale of other goods because the store might be able to sell more compared to the case when it doesn't serve these extra goods scarecely sold.

When a new telecommunication service is planned, it might not be easy for the most of the providers, i.e., telecommunication carriers, to tell whether it will be accepted by users or not.

A new service is always very difficult to be understood by potential users, and therefore difficult to be validated correctly in advance. In most cases, they cannot tell prior to their usage of it in practice whether they will surely subscribe to it and pay money. This is because a new service often applies new media, i.e., new terminals and/or new transmission networks, which might be beyond their understanding or imagination as far as they are not professionals in this field. It might be also because new media have been notorious for the presentation in jargon.

In these circumstances, it is rather dangerous to believe or rely on the result of any survey which claims to represent potential users opinion. They are often rather pros than cons for a new service until their curiosities, so to say, are satisfied by using it in practice.

On the other hand however, new services should be studied and provided because any service has its own life time and be replaced by new one, and because telecommunication carriers should not stay conservative to fulfil users requirements taking into account especially state of the art of technologies.

The department store approach would be a practical method to provide a new telecommunication service in such a case when its demands are uncertain and when a full line policy and an antenna shop function are requested. In this approach, the initial investment should be kept as small as possible and the freedom should be left open for possible withdrawal in the future when not successful.

3. Growth of facsimile transmission in Japan

As an introductory section to the following ones, some statistics are given to explain why KDD, the overseas telecommunication carrier in Japan, has been providing and planning various international telecommunication services for facsimile transmission.

It has been revealed that facsimile transmission takes 90 percent of non-voice telephone calls which reach 70-80% in the international subscriber dialing (ISD) calls from Japan to Europe and North America[1]. The ISD calls are around 70 percent of the total international calls. On an average, it is said that about 40 percent of the total international telephone calls originated in Japan are assumed to be for facsimile transmission. These facts tell how facsimile transmission is important in the overseas telecommunication in Japan.

Another statistics say that some 600 thousand Group 3 facsimile machines were installed in Japan during April 1984 through March 1985 as shown in Fig.1[2]. It is estimated that the number of facsimile machines nowadays in the world is above two million, among which one million are in Japan and a half in U.S.A.

Although it is believed the number of facsimile terminals in the world has already exceeded that of telex terminals, it will not be possible to reach that of telephone terminals, some tens or hundreds million. But this does not decrease any significance of facsimile transmission, and special and urgent attention should be paid by of telecommunication carriers because the number of facsimile terminals is growing and far larger than those of any other new media.

4. Networks for international facsimile transmission services

In this section are discussed international telecommunication networks and services in Japan which have been and will be available for facsimile information transmissions.

All the information to be transmitted takes the form of digital information in the case of Group 3 or Group 4 facsimile machines. Besides, there are various networks which can handle digital information. However, some networks may or may not be appropriate for the transmission of digital facsimile information in view of such features as transmission quality, response time and usage charges because they are not so designed to support facsimile communications. Hereafter are discussed the features of networks and services which can be used for facsimile and which are available or planned as the overseas telecommunication services provided by KDD.

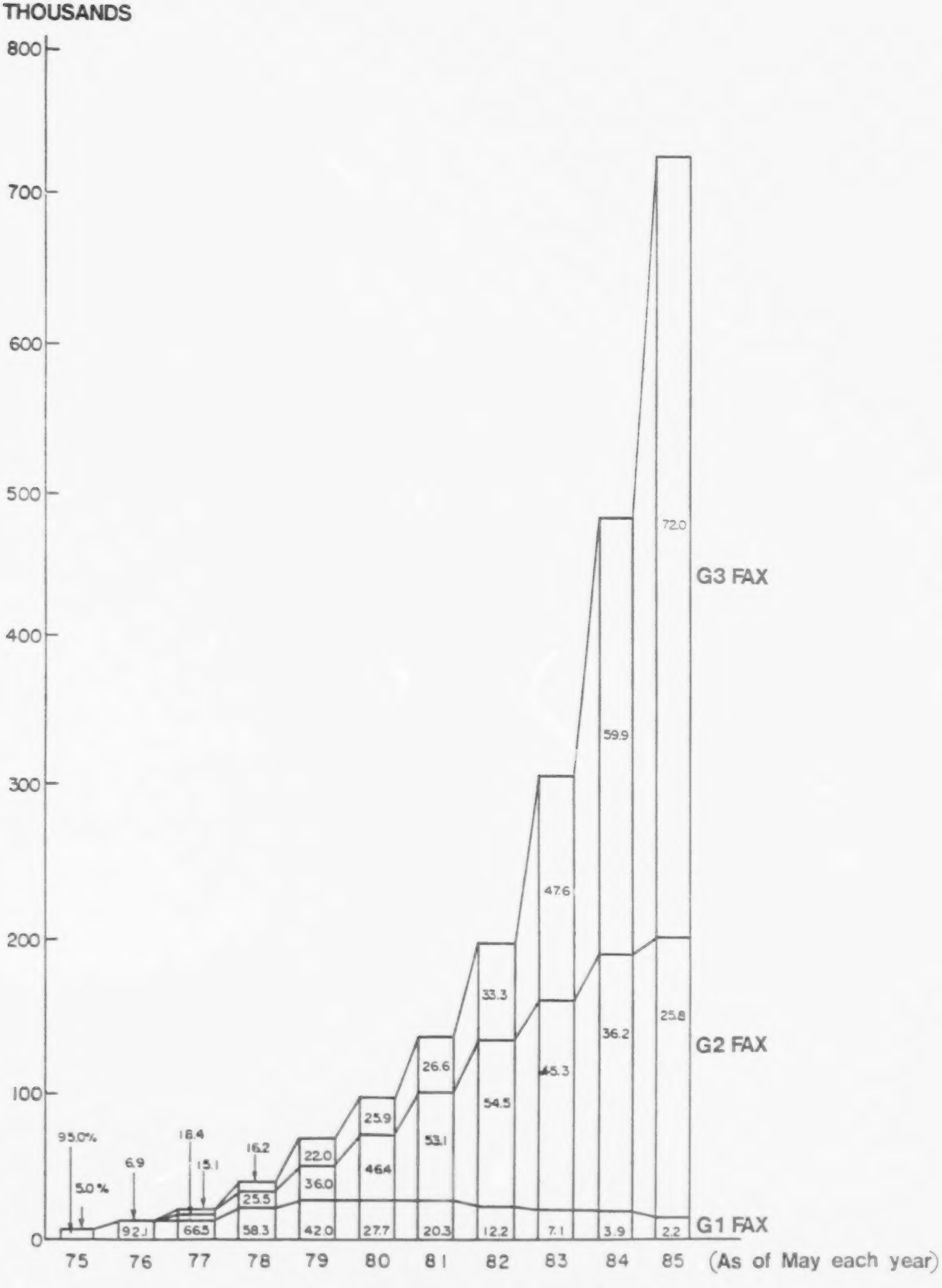

Fig.1 Growth of Facsimile Terminals in Japan

(1) Public switched telephone networks (PSTN)

It is possible to say that PSTN has been the most popular network in the world. Therefore, the rapid growth of the number of facsimile machines implemented in the world, especially Group 3 facsimile, is due to PSTN to the greatest extent. The main features of PSTN in light of facsimile communications are as follows;

a. Accessible in any place, office or home, by easy and same procedures,
b. Low cost, in may cases zero cost, at initial implementation,
c. Volume sensitive charge, at least for international transmission,
d. Unattended operation,
e. etc.

(2) International facsimile transmission service

In order to offer better facsimile transmission capabilities to the users of PSTN, provision of such additional facilities as storage file and multi-address delivery by Message Handling Systems (MHS) is being planned[3]. The type of terminal initially supported will be Group 3 facsimile machine.

(3) Packet switched public data networks (PSPDN)

PSPDN has been growing rapidly in almost all counries although it is a rather young public network compared with PSTN. Packet switching technology can be applied to such bulk data transmission as facsimile or file transfer as well as to such small volume one as interactive access to computer. However, it is not true in practice to say that PSPDN existing today, national or international, is an optimum medium for facsimile communication. This is because PSPDN has been initially implemented for such interactive applications as remote computing or database access, and because the charging scheme of it is rather small volume oriented.

To break through these situations, it is planned in some countries that a new packet switched network service, tentatively called High Speed Data Transmission Service (HSDTS), be implemented independent of existing packet switched networks. HSDTS is also a packet switched public data network and the difference from existing PSPDN are such that the charge is planned to be bulk data oriented and that a long packet size, e.g., 1 k byte, is supported to meet the requirement for quick transmission of documents by Group 4 facsimile machines.

There is no difference between HSDTS and existing PSPDN in view of switching technology applied. Both adopt such international standardized protocols as CCITT X.25 for network access protocol, X.75 for internetwork protocol and X.121 for numbering plan. But it is left for farther study such issues as the interconnection of HSDTS and existing PSPDN or integration of two services into one. There are some reasons for this situation, two out of which are the difference of charging scheme and the support of long packet.

KDD has inaugurated international PSPDN service called VENUS-P in 1982 and now plans to introduce international HSDTS service around the end of 1986.

The main features of existing PSPDN and HSDTS are as follows;

(Existing PSPDN)

a. Global network next to PSTN,
b. Interactive application oriented,
c. Error free transmission,
d. Quick response time,
e. etc.

(HSDTS)

a. Limited service area,
b. Bulk data oriented,
c. Error free transmission,
d. Quick response time,
e. etc.

(4) Circuit switched public data networks(CSPDN)

There are two kind of technologies to realize public data networks; packet switched public data network (PSPDN) and circuit switched one (CSPDN). The advent of technical standards for CSPDN was earlier than that for PSPDN because CSPDN was rather easy to be understood in the association with PSTN. However, the growth of CSPDN has been very slow as a global network compared with PSPDN which has been extended almost all over the world since around 1980.

KDD plans to introduce international CSPDN service tentatively called VENUS-C in 1987.

The main features of CSPDN are as follows;

a. Bulk data oriented,
b. Error free transmission,
c. Quick response time,
d. Limited service area,
e. etc.

(5) Private network based on leased circuits

To use international leased circuit service is the most economical when there are very large traffic volume between two points, because the charging scheme for leased circuit is flat rate while the ones for such public services as PSTN or PSPDN are volume sensitive in principle. This leads to the introduction of private network based on international leased circuits when there are rather large traffic volume among multiple points in the world. Leased circuits are of

Table 1 Services Provided by K.D.D. Applicable to Facsimile Transmissions

International Telecommunication Services	Facsimile Terminals Applicable	Physical Networks	Features in View of Fax Transmission
1. International Telephone Service	G3	PSTN	(1) Widespread network in the world - easy to access at any place. (2) Low initial cost. (3) No need of specific operational procedures.
2. International Facsimile Transmission Service using PSTN (planned)	G3	PSTN with additional S/F facilities	
3. International Data Transmission Service			
(1) Packet Switched	G3*/G4	PSPDN	(1) Growing network in the world. (2) Rather expensive charge. (3) Good transmission quality.
(2) High Speed Packet Switched (planned)	G4	PSPDN	(1) Cost effective for bulk document transfer. (2) Good transmission quality. (3) Good throughput. (4) Limited service area.
(3) Circuit Switched (planned)	G3*/G4	CSPDN	(1) Cost effective for bulk document transfer. (2) Good transmission quality. (3) Good throughput. (4) Limited service area.
4. International Leased Circuit Service	G3/G4	Private Network	(1) Most economical for special purpose - bulk data transmission in limited area. (2) Expensive for low traffic volume. (3) Protocol free.

(*) Interface adapters are necessary.

cause applied under certain international regulations and users of them need their own considerations for recovery in case of circuits failures. The main features of private networks are as follows;

a. Optimum network for specific application,
b Protocol free (no restrictions for logical interfaces between terminal and network),
c. Limited service area,
d. Necessity of considerations for certain availability of network,
e. etc.

5. Department store approach to facsimile transmission

KDD has taken the department store approach, intentionally or not, to the provision of international facsimile transmission services, trying to satisfy varios requirements of business and private users. As described in the previous section, there are several networks and terminals, including those planned, which are applicable to the international facsimile transmission. Features of each element for the international facsimile transmission will be discussed here from a point of view of a telecommunication service provider.

5.1 Environments of users

The rapid progress of office automation (OA) has been talken in parallel with the outcome of communicating OA devices; personal computers, communicating word processors, digital PBX, telephone sets with multiple functions, etc. Among those devices, facsimile terminals might be one of the most important and therefore the most popular ones in offices.

The reasons why so many facsimile terminals are used will be as follows;

a. Unattended reception,
b. Content free,
c. Easy operation,
d. Non-expensive terminal,
e. Non-expensive communication charge,
f. etc.

Unattended reception of facsimile message is convenient especially when there is time difference between sending and receiving points. There may not be so many cases in daily business communications when a response on the spot is indispensable.

"Content free" is one of the well known features of facsimile, by which drawings or special symbols can be transmitted in addition to typewritten characters.

Easy operation is a very important factor if any terminal device is widely accepted in the world. It is so easy in fact to use a Group 3 facsimile terminal attached to telephone network (PSTN) as to use a telephone set or a copy machine.

From economical viewpoints, facsimile terminals are getting cheaper every year and Group 3 facsimile terminals are sold today at a fifth or less of the price a few years ago. The communication charge for transmitting a full A4 page of message is normally equal to or less than that of one minute telephone call. The information contained in an A4 page might not be able to be transmitted orally in a minute.

As to the transmission quality of facsimile, some users will prefer strongly higher quality than that of current Group 3 facsimile. They want to have a copy transmitted to a remote place completely in the same quality as a local one. Such requirements will be satisfied by new Group 4 facsimile.

5.2 Facsimile terminal

It is possible to say that Group 3 facsimile terminal machine has already superseded Group 1 or 2 as shown in Fig.1. Group 3 machine might owe its growth to the standardization by CCITT as Recommendation T.30 in 1980.

Group 4 machine has been standardized also by CCITT in 1984 as Recommendation T.5 and other related Recommendations. Group 4 facsimile machine enables to reproduce in a remote place a copy of virtually same quality as a local one. However, it is rather expensive tody compared to Group 3 machine, the quality of which is acceptable enough to most of applications. Therefore, Group 4 facsimile will be used to a certain extent by those users who prefer quality to cost for the time being until the price of it will be lowered by technical inovations.

5.3 Networks

As described in the previous section, there are six international telecommunication services of KDD applicable to facsimile transmission, among which three are provided and three planned. Except one out of these services, they are or will be provided by physical networks in practice, i.e., public switched telephone network (PSTN), packet switched public data network (PSPDN), circuit switched public data network (CSPDN), and international leased circuits for pivate networks. These networks provide services up to layer 3, network layer services associated with Open Systems Interconnection (OSI) reference model [4, 5]. Any terminal, not only facsimile one, can access to them and use them as data transfer media as far as it is equipped with such network defined protocols as X.25 for PSPDN and X.21 for CSPDN.

In the circumstances, users will be left free to choose a service considering such factors as charges, volume of documents, cover areas, terminal cost, terminal operators, etc.

It should be kept in mind that these public networks have not been designed to meet a specific, i.e. facsimile, application. Rather they have been designed to be applied to a need on an average at an optimum cost. Then the international facsimile transmission service, as planned, will appear to fill a gap between a specific and an average need.

The planned international facsimile transmission service is not associated with a physical network. It is a virtual network, or, in other word, a service network initially based on PSTN. It resembles the electronic mailbox service in which PSPDN, PSTN and Telex network are used as physical networks for it's access or message distribution.

5.4 Department store approach

It is often difficult for a single telecommunication service to meet completely all requirements of users, which differ user by user and scometimes change time by time. A public service is apt to be compromised or optimized to satisfy various requirements as an average. A single telecommunication service may be associated with goods in a specialty shop, where customers can find only one service already tailored to one model of utilizations, although it may be of high quality. In this case, customers are not allowed to enjoy selection of services.

The risk of excessive investments to inaugurate a new service should be avoided as far as possible when the demands for it cannot be estimated correctly. But on the other hand, a new service should be provided to meet potential demands or to get strategically a better position in competitive circumstances.

The issue of the international facsimile transmission has been very important to us because the traffic volume grows rapidly every year and because it is not clear whether customers will stay on using PSTN for overseas facsimile transmission by Group 3 machine or they will prefer additional store/forward facilities. In addition, they may shift from Group 3 machine to Group 4 by preference of high quality.

"Department store approach" has been taken to break through this situation in stead of "specilty shop approach". Various services applicable to the international facsimile transmission have been provided or planned as shown in Table 1. These services may be associated with various goods in the showcases of a department store. It is up to customers selection which service(s) they choose. The risk is minized because the application of each physical network, PSTN, PSPDN or CSPDN, is not restricted to facsimile alone. Each network will be used for voice transmission or data transmission of intelligent terminals in OSI environments.

The integration or interconnection of these services may be necessary in the future and will be studied when the users' preference will become clear after some years of experience.

6. Conclusion

Two extreme approaches to the unpredictable market of new telecommunication services are discussed. "Department store approach" would be preferable to "specialty shop approach" when a service provider should meet versatil requirements of customers.

As a case study, various services of KDD for international facsimile transmission are introduced and discussed in relation with "department store approach".

The integration or interconnection of these services are left for future study.

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"Cellular Communications, The New Medium"

The Los Angeles Experience

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Since the introduction of personal computers, no single technology has attracted as much attention or created such excitement as cellular communications. Cellular Radio has been a much publicized and debated technology and its commercialization has brought about significant changes in the make-up of the telecommunication industry worldwide.

As we know, Cellular (Radio) was first implemented on a large scale basis in Sweden in late 1981, mid 1982. Denmark, Finland and Norway had joined to form the Nordic Cellular System, giving our industry a new formal standard known as the Nordic Mobile Telephone Telephone, or NMT. By mid-1982, trails in Chicago were underway for an 800 mHz system conceived by Bell Labs capable of delivering more efficient use of the spectrum and designed to handle higher traffic loads. Different from the NMT System which operates on 450 mHz, this new standard was to be known as AMPS, or Advanced Mobile Phone Service. This new service was to have a profound impact on the lifestyles of thousands as it was introduced to the mass market in major metropolitan areas throughout the United States.

The Los Angeles Experience

In June 1984, Los Angeles became the eighth city in the United States to offer cellular mobile telephone service. With 16 cell sites in operation, the system was activated in time to help the communications needs of the 1984 Olympic Games. In October, 24 cell sites were fully integrated and balanced, providing service to an area of 4,500 square miles. By August 1985, PacTel Mobile Access, which built and operates the system for the Los Angeles Limited Partnership, had expanded the system to include 29 cell sites which covered a 6,500 square mile area and provided service to over 32,000 subscribers.

As of November 1986, Los Angeles had become the single largest system in the United States with 60 cells in operation covering 8,200 square miles and providing service to more than 74,000 customers.

Constructing the Los Angeles system provided a challenging opportunity for Pacific Telesis to test the limits of cellular system design.

The Los Angeles Cellular System

The Los Angeles cellular system covers an 8,200 square mile area, stretching from Ventura County to South Orange County, and from 14-miles offshore to the east Los Angeles County border. Diverse topographical elements which characterize different geographic regions of the United States can be found within the Los Angeles cellular geographic service area (CGSA). Mountains, canyons, riverbeds, flatlands, and coastal waters make up the rural and city environment. Temperatures reach as high as 100 degrees Fahrenheit and wind conditions can range from 50 to 70 MPH. Steel and concrete structures coupled with freeways stacked four high dot the sprawling downtown area of Los Angeles and the rapidly growing Orange County and San Fernando Valley business centers.

The obvious challenge facing Pacific Telesis was to design a system capable of providing coverage across such a diverse geographic area - an area which is home to more than 11 million people. Optimum cell site locations, available interconnections and growth capacity were identified as the key factors for successful system design.

Cell Site Locations

The original system was designed to include 24 fully integrated cell sites to provide coverage over a 4,500 square mile area. Before potential sites were selected, topographic and demographic maps were studied to determine the cellular grid orientations that made the best use of natural boundaries. A 10-mile grid chosen to identify the cell sites, and a 5-mile grid was placed over that to establish the 7-cell frequency reuse pattern.

A top priority for high quality mobile telephone service is site location. The design criteria require at least a 90 percent probability that a mobile unit will receive a signal of -100 decibel referred to 1 milliwatt (dBm) or greater at any point in the system. To predict high-quality service areas, computerized propagation models were utilized. Pacific Telesis is now using a specially-designed propagation analysis system to ensure that a cell site can guarantee optimum coverage and high-quality service.

The most time consuming aspect of selecting the cell sites, and at times, the most frustrating, was acquiring the property and securing building permits. In the Los Angeles market, where municipalities maintain their own zoning regulations and building restrictions, our real estate and construction staffs worked with 16 local jurisdictions to obtain building permits for the original 24 sites. This experience confirms that it takes from nine to 12 months to select, acquire, and build a single cell site.

Growth forecasts were crucial to the design of the LA system. Once the general locations of the cell sites and the mobile telephone switching office (MTSO) were determined, marketing studies were used to forecast the distribution of traffic by cell site. Not only did these studies allow us to predict growth on a cell-by-cell basis, they also assisted in determining the number of radios to be allocated to each cell.

We have now a much better appreciation for the value and importance of optimum cell site location. The complexity varies to a degree of depending on the city. And although it may be easier to find optimum cell sites in Honolulu than in Hong Kong or Tokyo, other factors come into play to make this phase of the system construction a very critical one.

System Balance

Another factor accounted for in the selection of cell sites for the Los Angeles system was system balance. Cell sites should be strategically located so they are in balance with one another and the MTSO. As a cell site is added to the system or the number of radios in a cell is increased, the threshold of every cell site must be re-evaluated to maintain the proper balance. The threshold, which is the pre-determined level of signal strength, must be set at precisely the right radio frequency (RF) signal strength to accommodate the needs of the system.

Interconnection

Pacific Telesis was determined to reduce the interconnection costs and the cost of completing a call within the CGSA, both from a mobile to a landline phone and from a landline to a mobile. By minimizing the distance between the cell sites and the MTSO, and between the MTSO and the zone offices, this was accomplished.

The Los Angeles CGSA is served by four numbering plan areas (NPAs) and two dedicated NXX codes were requested in each of the NPAs. Six class 5 zone offices were selected on the basis of the size of the exchange areas served.

Interconnection to the telephone companies was a critical timing issue in Los Angeles because Pacific Telesis was committed to being on line in time to service the 1984 Summer Olympic Games. Cost and efficiency were also important considerations, but the service target date made timing the priority. As a result, existing telephone company tariffs were used to expedite due dates for data links, voice circuits, and zone office trunks. Once crucial dates were met, timing became less significant and cost-effectiveness more important in determining interconnection.

Today, we are evaluating the use of high capacity lines, T1 digital spans, and microwave interconnections as means to reduce interconnection costs.

The final choice for interconnection of the cellular system to the public network will vary, will have economic and functional trade-offs, and will invariably be subject to some restrictions.

System Growth

One of the most challenging aspects of operating a cellular system is meeting an unexpected demand for service. As the number of cellular subscribers grows, the engineering department must implement appropriate technologies to satisfy the increased demand. Adding new technologies, new cells, cell-splitting, and directed re-try are some of the ways to accommodate a rapidly growing customer base.

The length of time it takes to acquire and build new cell sites -- a time that can take from 9 to 12 months -- requires measures that can be taken to provide interim service. Portable cell sites can be used while waiting for building approvals from local jurisdictions.

In central business districts and on major routes that connect densely populated residential areas to these business districts, utilization of the full spectrum of available channels is required. Responsive activities such as cell site splitting, antenna directionalization, power reduction, and tower height reduction can be employed to balance the distribution of customers within cells, especially during peak loads.

Traffic demand can be met by increasing the number of radios within individual cells. In the original Los Angeles system, the maximum number of radios planned for each cell was 45. Today, many cells have 90 radios and, we are working towards one-mile radius cells in some areas.

Directed re-try is also carefully employed in the Los Angeles system to accommodate heavy usage areas and peak usage periods. Directed re-try groups four or five cells together so that calls normally handled by a very busy cell site are automatically transferred to a predetermined less busy cell site with less traffic. If all channels in that cell are also busy, the call is directed to a third or fourth cell site.

Conclusion

Building the Los Angeles system has been an extraordinary experience and the job is far from finished. Engineering adjustments will continue as long as population shifts occur, business centers emerge, freeways are built, portable cellular telephone usage increases, and demand grows.

Cellular telephony is fast becoming the telecommunications medium of tomorrow. Already cellular service is changing the way people do business. As the costs for terminal equipment and service are reduced, cellular service will become more affordable, making it a commodity for people from every profession and economic group. And, with technological advancements continuing to improve system and equipment design, cellular service will become more convenient and efficient for the cellular subscriber.

Pacific Telesis is proud of the role it has played in bringing cellular service to Los Angeles, and looks forward to making further contributions to the rapidly growing communications industry worldwide.

ANALYSIS OF NTT'S TELEPHONE CARD MARKETING

- Case Study of User Participation for Making Successful Telecommunication Products -

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1. INTRODUCTION

NTT first began installing magnetic card-use public telephones in December 1982, and at the same time started selling magnetic cards, providing prepaid calling credit, for use with these telephones.

Telephone card sales have shown explosive growth in the years since then. By July 1986, the cumulative number of cards sold had topped 100 million, thus making a substantial contribution to NTT's revenues. One factor promoting this phenomenal growth has been the public's recognition of the convenience of using telephone cards. This awareness has heightened as the number of card-use telephone installations has increased. Beyond this, a more important factor has been the deployment of various marketing strategies by NTT to create a "telephone card boom" that has engulfed users.

This paper first gives a general explanation of the basic features of a telephone card and card-use public telephone. It then probes the reasons behind the immense success of telephone cards as a new product and analyzes the different strategies being used by NTT in marketing them.

2. WHAT IS A TELEPHONE CARD?

2.1 Description

A telephone card is made of a polyester resin and is coated with a magnetic material on the backside. The number of call units possible with a card is prerecorded in this magnetic material. To operate a card-use public telephone, a user simply inserts the card into the instrument. The number of units consumed by a call is entered on the card each time it is used. When the number of prerecorded call units is reached, the card becomes unusable. The external appearance of a telephone card is shown in Fig. 1, while its feature is listed in Table 1.

Four types of cards are currently being sold, which provide 50, 105, 320 and 540 call units. These cards sell for 500, 1,000, 3,000 and 5,000 yen, respectivelty. Since the ordinary charge for a three-minute call is ten yen, the 1,000 yen and higher cards give users a discount ranging from 4.8 to 7.4%.

Telephone cards fall into two broad categories. One category consists of general cards which are designed, printed and sold by NTT. The other category is referred to as "design cards." These cards are designed according to the customer's wishes, and the entire lot is purchased by that customer.

General cards come in two types. One type consists of national cards which are planned at NTT's Head Office and sold throughout the country. The other type consists of local cards that are planned and sold by organizations in each local community.

Design cards also fall into two types, the free design card and the model design card. The former card is designed entirely by the individual customer. The latter card has a given design, to which the customer may add a message, photograph or some other desired feature.

2.2 Card-use Public Telephone

At the time the card-use public telephone was put into service there were only 300 installations. This figure has been greatly expanded since then to reach 61,000 installations at the end of March 1986. NTT plans to have 146,000 card-use public telephone in operation by March 1987 (see Table 2).

The first card-use public telephones were installed only in telephone booths and they took coins as well as cards. Since then, desk-top varieties have also been introduced, some of which are designed for cards only and others take both cards and coins. The added versions have greatly expanded the possible locations for installation and have contributed to the continued increased in the number of card-use telephone in operation.

The major features of card-use telephones include: an LED display of the remaining call units, the capability of accepting a second card, a sound and flashing LED indication ten seconds prior to the termination of credit, a function for punching a hole in the card to indicate the amount of credit remaining and a sound warning when a call is terminated to alert the user not to forget the card.

Figure 1. Telephone card external appearance

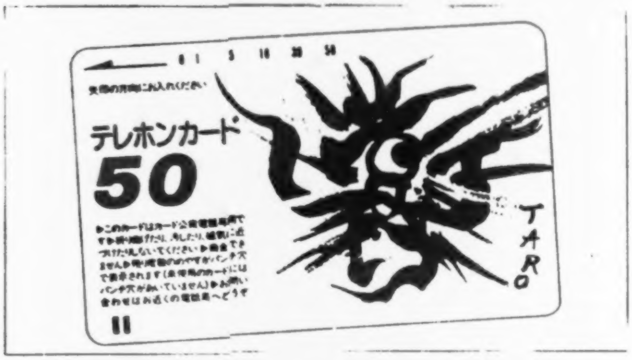


Table 1 Telephone Card Details

	Telephone Card	Standard "bank card" (Disignation in Japan)
Recording Layer	Magnetic material coating	Magnetic material stripe
Shape	86×54(mm)	86×54(mm)
Substrate Material	PET	PVC
Selling Price	500, 1,000, 3,000, 5,000(yen)	

Table 2 Public Card-Using Telephone Installation

			83.3	84.3	85.3	86.3	87.3
Cards	Cards only		–	–	5	8	46
	Cards & Coins	Desk Type	–	–	–	–	1
		Booth Type	0.3	3	14	53	99
	Card-Using Telephones total		0.3	3	19	61	146
Public Telephones in total			928	931	935	910	800
% of Card-Using Telephones			0.03	0.3	2.0	6.7	18.2

Table 3 Historical Data of Telephone Card Sales

Fiscal Year	1983	1984	1985	1986	1987
Number of sales (1,000 cards)	70	1,550	9,350	60,360	100,000
Amount of sales (million YEN)	65	1,225	7,035	40,255	67,000

Fiscal Year ends on March 31 of each year.

2.3 Benefits of Telephone Cards

Telephone cards provide both users and NTT with a host of benefits. The advantages to users include:

- There is no need to carry around change for making telephone calls.
- The bother of putting in coins is eliminated.
- A discount can be obtained on call charges.

The benefits to NTT include:

- The prepaid system contributes to an operating funds surplus for the company.
- The time and cost needed to collect coins from public telephones is significantly reduced.
- There is no danger of burglary and vandalism.

3. THE SUCCESS OF TELEPHONE CARDS

3.1 Sales and Contribution to NTT

Sales of telephone cards topped the 100 million mark at the end of July 1986, only three years and seven months since they were first introduced. The change in sales each year is shown in Table 3, which clearly illustrates the extremely high growth rate achieved by telephone cards. An analysis of the sales figures for general and design cards indicates that the latter's ratio to total sales has been increasingly rapidly.

Revenues from telephone cards exceeded 40 billion yen in fiscal 1986. It was initially estimated that telephone card sales would reach the 100 million level in fiscal 1987, generating 60 billion yen in sales income. Since sales have been proceeding smoothly down to the present, it is virtually certain that both these targets will be achieved.

3.2 Spread of Telephone Cards

Telephone card sales did not rise very much during the first year they were on the market. One reason is that only a small number of card-use public telephones had been installed at that point. Another reason is that the level of public awareness was still rather low. However, as a greater variety of designs began to appear from the end of 1983 through the first half of 1984, card sales soared rapidly, especially among young people.

As telephone cards gained in popularity and reached a certain level of diffusion, they began to be used as sales promotion items, souvenirs, gifts and for other purposes as well. The appearance of the design card in particular brought about a sharp increase in demand for this type of telephone card.

As the variety of card designs continued to expand, telephone cards began to attract attention as a collector's item. This led to the formation of a premium card business, which capitalized on the free design card to create cards especially for collectors. The net result has been to further accelerate the sales of design cards.

3.3 New Sales Promotion Giveaway

There are a number of conditions that a product must meet in order to be used in large volumes as a sales promotion giveaway. First, it must be reasonably priced. Second, it must be capable of serving as an appropriate medium for advertising the product it is supposed to promote. Third, it must be capable of creating a significant advertising effect within a given period of use. Fourth, the recipient should feel happy to use it. The design card is a product that meets these conditions perfectly, and this is one reason behind its overwhelming popularity.

Small and medium-sized enterprises and retail stores in Japan often advertise their business through small gifts that are given to customers at mid-year, year-end or as commemorative items to celebrate the opening of a new store. Initially, the model design card was a favorite choice for use in this capacity because it was relatively inexpensive to produce (see Table 4). Later, though, as telephone cards have grown in popularity, the free design card has come to be used with increasing frequency because it allows customers to make the most of the original design feature.

The free design card accounts for the vast majority of cards purchased by large companies, which use these cards in many diversified ways. Corporate advertising is of course a primary example, but they are also employed as promotional tools in a variety of campaigns, such as for certain products, events, new TV programs and newly released songs. There is virtually no end to their uses and new ideas for using telephone cards are appearing practically every day.

3.4 Commemorative Item Market

In Japan there is a custom of giving a commemorative item to friends and relatives to celebrate a special occasion of personal significance. Typical examples include commemorative items that newly-weds give to celebrate their marriage or small gifts given by parents to celebrate the birth of a new baby. Telephone cards have found widespread use as such commemorative items.

In selecting an item to be given in commemoration of some occasion, the giver wishes to make a good impression on the receivers by giving something that will reflect the individual's personal taste. At the same time, the giver wants everyone to be happy to receive the gift.

The design card fulfills these two requirements perfectly. The design aspect allows the giver to

Table 4 Price of Design Card (thousand YEN)

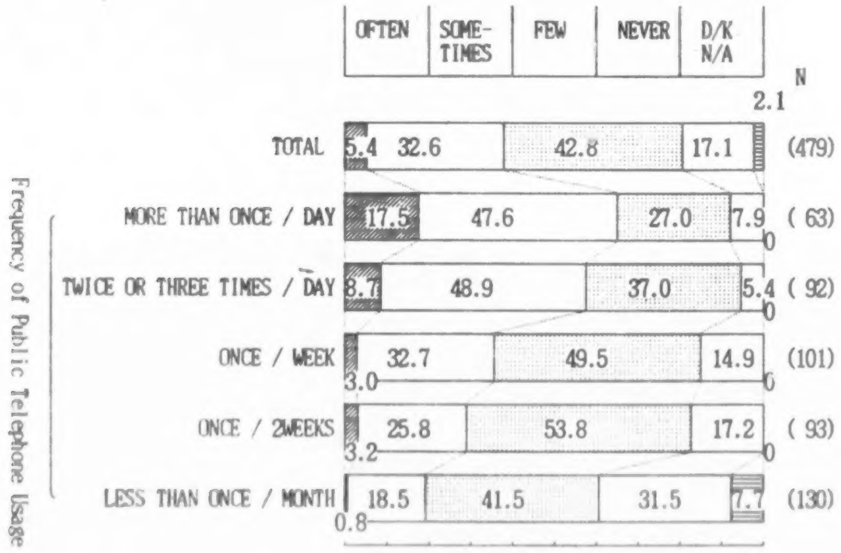
(Free Design Card)

number / Card Type	500	1,000	3,000	5,000	8,000	10,000
50 units	413	725	1,975	3,225	5,100	6,350
105 units	725	1,350	3,850	6,350	9,910	12,290

(Model Design Card)

number / Card Type	50	100	200	300	400	500	800	1,000
50 units	35	66	129	191	254	316	504	629
105 units	66	129	254	379	504	629	979	1,213

Fig. 2 Experience of not having change necessary for making a call



display his or her own originality. The telephone card itself is a product form of telephone service, which is something that nearly everyone needs at some time.

There is one more factor behind the popularity of telephone cards as commemorative items. Through the act of giving a commemorative item people want to achieve smooth relations with others. Telephone cards represent telephone calls in the form of a product, and thus they are useful tools for effecting smooth interpersonal relations with other people. In this sense, they are perfect as commemorative items.

3.5 Gift Market

For the same reasons that telephone cards have been well received by users as commemorative items, they should also find acceptance as personal gifts given from one person to another. However, in order to make a suitable personal gift, the giver would have to buy a certain number of cards all at one time. This puts certain limitations on the design card for personal gift use.

To overcome this problem NTT has developed and put on sale the "white card," which is intended to make telephone cards more usable as personal gifts. Since this card is nearly blank, it allows the giver to write a message, draw an illustration or add some other personal touch for the receiver. The white card is now widely used in place of traditional greeting cards for such occasions as birthdays, Christmas and Valentine's Day. The main users are young people who use the telephone as an important communications tool for staying in touch with friends.

3.6 Collector's Item Market

Once collectors became interested in telephone cards because of the wide variety of designs that were being produced, cards began to be made and sold with them in mind. An awareness of the existence of collectors can be seen in the case of NTT regional telephone cards. The rapid increase in the number of these cards being issued is one indication of the rising "collection fever" for telephone cards. It is reported that there are presently more than 200,000 telephone card collectors in Japan.

Certain businesses have sprung up outside of NTT that produce telephone cards specifically for collectors. Typically, these businesses make original design card and resell the cards at a premium price; for instance, a 500-yen card might be sold for anywhere from 800 to 1,000 yen. Primary examples of such cards include: those with photographs of popular movie stars, a series of cards featuring works of art or the performing arts and cards issued to commemorate some special event, for example the visit to Japan by Prince Charles and Princess Diana.

The immense interest that telephone cards have attracted as a collector's item has led to the creation of a resell market for cards that have already been issued. In this market, cards are bought and sold at a premium. There have even been cases where a 500-yen card was priced at over 100,000 yen. In response to the formation of this resell market, telephone card catalogs and newsletters have also appeared. The resell market has not contributed directly to NTT's earnings, but it has played a significant role in firmly establishing the telephone card as a collector's item.

4. ANALYSIS OF TELEPHONE CARD MARKETING

4.1 Customer Needs Analysis

The starting point for the development of telephone cards and card-use public telephones was the assumption that there were strong needs for public telephones which could be operated without using coins. In line with this assumption, surveys were carried out to assess user acceptance of coinless public telephones and the concept of card-use public telephones.

The survey findings indicated that there were large numbers of people who had experienced the following situations. "I needed to make a call but I didn't have any change." "I ran out of change in the middle of the conversation." "It was a bother to have to put in coins all the time." Such responses were particularly frequent among people who said they often used public telephones. (See Figs. 2, 3 and 4.) A survey conducted among business people showed that they tended to experience such problems even more frequently. (See Fig. 5.) The findings thus confirmed that there was a definite basis for consumer acceptance of telephone cards, which would be easy to carry and would do away with worries about not having any change.

In another survey on consumer attitudes toward telephone cards the aspect appreciated the most was the fact that coins were not needed. The second most frequently given response was a strong expectation of receivig a discount on card prices. (See Fig. 6.) The findings indicated that young male consumers, a segment highly receptive to new products, would be among the most frequent users of telephone cards. (See Fig. 7.) This result suggested that promoting telephone cards as an "image product" would be an important sales strategy.

From the beginning it was assumed that telephone cards would be purchased as gifts and as sales promotion giveaways. The results of a survey conducted prior to putting telephone cards on the market confirmed the potentialities of these uses.

Fig. 3 Experience of running out of change during the conversation

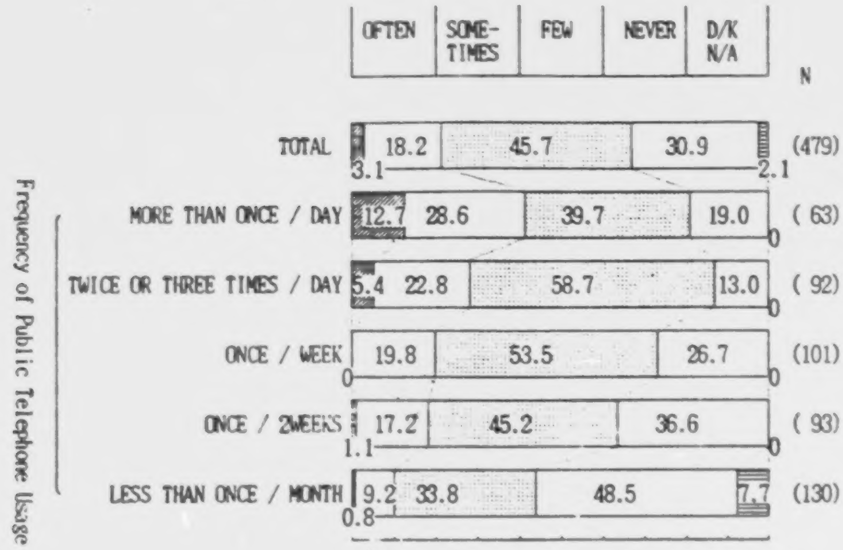


Fig. 4 Experience of the inconvenience of inserting coins repeatedly

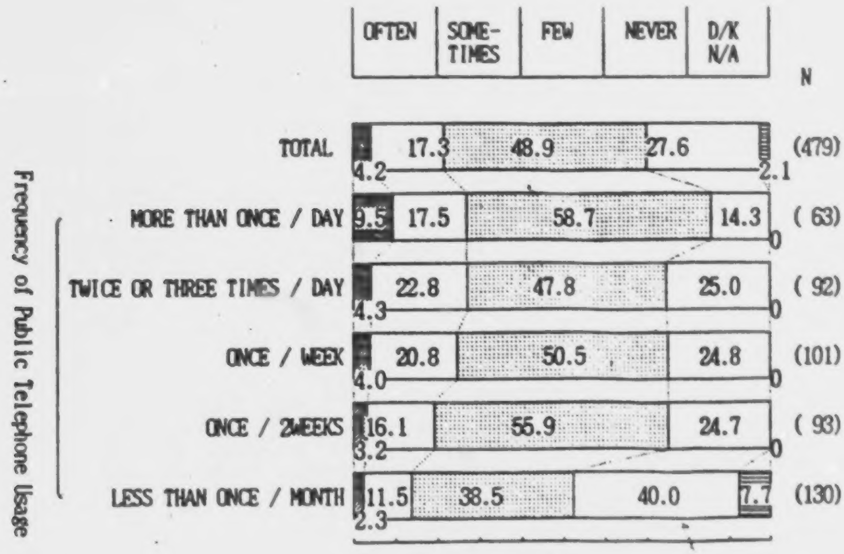


Fig. 5 Experience Summary (Salespersons)

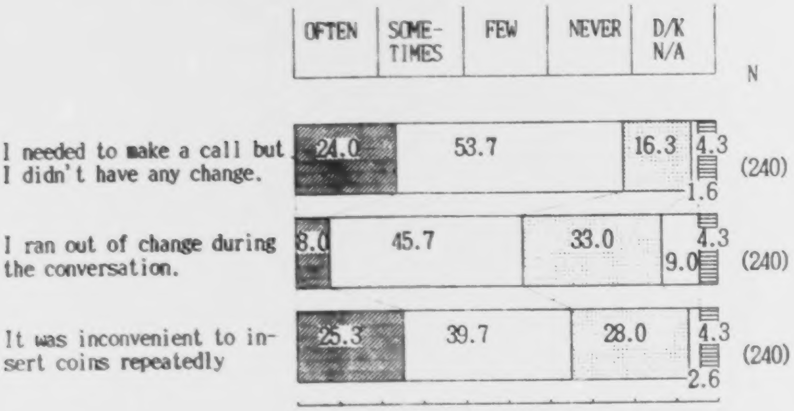


Fig. 6 The reason for using Telephone Card

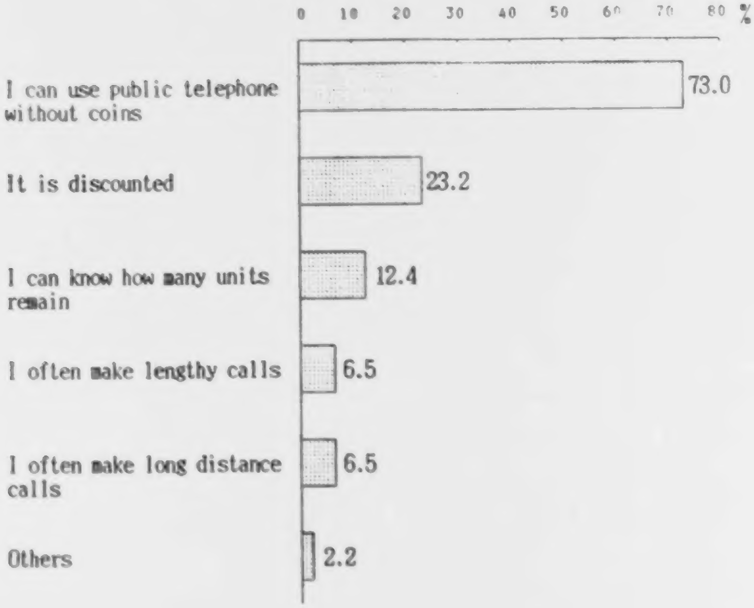


Fig. 7 Desire to use Telephone Card

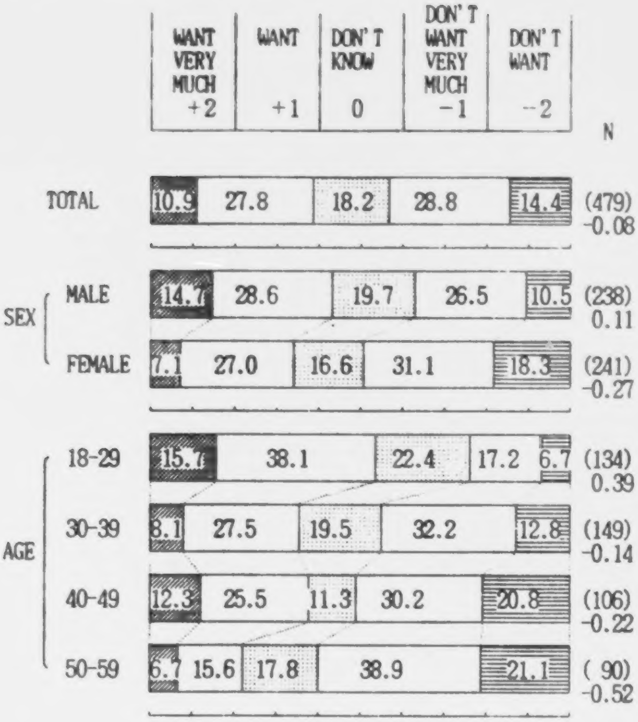
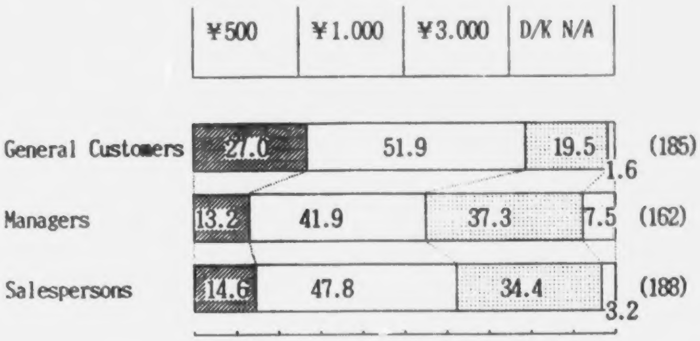


Fig. 8 Preffered price for Telephone Card



4.2 Product Concepts

There are three slogans associated with telephone cards. "They're handy to use." "They're satisfying to give." "They're fun to collect." These slogans aptly express the product concepts underlying telephone cards. At NTT we have developed our telephone card marketing strategy around these three concepts.

Concept 1: A product that will eliminate the inconvenience of public telephones

The survey findings mentioned in the previous section revealed that there was considerable dissatisfaction associated with the use of coins in operating public telephones. Telephone cards are intended to dispel that dissatisfaction.

Concept 2: A product that can be used as a gift or sales promotion giveaway

It has already become clear that telephone cards have the attributes of a product that can be used as a gift or a sales promotion giveaway. Acceptance by consumers has greatly exceeded our expectations at the time the surveys were conducted. This concept has become a central pillar of our marketing strategy for telephone cards.

Concept 3: A product that will become a collector's item

It was predicted that telephone cards would become a collector's item for a number of reasons. They allow a variety of designs, are easy to preserve and are a product of NTT, a company of no little prestige. It should be noted that NTT has never issued a card with the expectation that it would become dead stock. However, it has been necessary to give consideration to certain aspects of telephone cards in order to cultivate interest in them among collectors.

4.3 Pricing Policy

Telephone card prices had to be set so that they would be in line with the three product concepts mentioned earlier.

A survey was carried out to investigate suitable price levels from the standpoint of the consumers who would be using the cards. The results indicated there were strong needs for cards carrying larger monetary values. Ordinary consumers expressed a preference for 1,000-yen cards, while managers and people involved in sales indicated a preference for 1,000 or 3,000-yen cards. (See Fig. 8.)

Suitable prices also had to be determined from the standpoint of gift use. Given the nature of the product, it was assumed that people would probably give a certain number of cards together as one gift. Since a reasonable price would be the determining factor in this case, it was concluded that 500-yen cards would be necessary.

In view of these pricing considerations, we decided on 1,000, 3,000 and 5,000 yen as the prices for cards aimed at consumers who mainly wanted convenience. A price of 500 yen was set for cards aimed at consumers who would buy them as gifts or as a collector's item.

4.4 Promotion Strategy

The primary emphasis in sales promotion was initially placed on raising public awareness of telephone cards. Efforts were exerted to make telephone cards a topic of conversation. Toward this end, cards were put on the market which featured a design created by a famous designer or a popular cartoon character. After a certain level of public awareness had been obtained, sales promotion emphasis was shifted to the three product concepts mentioned before.

(1) Efforts to enhance the benefits of telephone cards

The most important factor in promoting the convenience of telephone cards for users is to expand the number of card-use public telephones. Coin-use public telephones are now being replaced with the card-use versions so that in the near future it will be possible to operate all public telephones with a telephone card.

An addition, a discount system has been introduced for higher priced cards in an effort to encourage people to use cards when making telephone calls.

(2) Efforts to promote use of telephone cards as giveaways, commemorative items and gifts

Sales promotion activities in this area include an effort to prevent users from losing interest in the design aspect. In this connection, more diversified designs are being introduced for the easy-to-use model design cards and white cards, and design changes are being carried out periodically.

Steps have also been taken to allow messages to be printed on model design cards in multiple colors, whereas only black was available initially. It now possible to print photographs on these cards as well. Both of these innovations have been made in recognition of users' needs. In addition, NTT has also started to provide a numbering service for telephone cards. This is in response to the demand that telephone cards be able to serve as a membership card or a lottery ticket.

Advertising for telephone cards has stressed their creative aspect, as well as the concept that telephone cards are a handy communications tool. This idea is being promoted through the slogan: "Let a telephone card keep you in touch with friends and loved ones."

(3) Efforts to promote telephone cards as a collector's item

A variety of approaches are being taken to promote sales of telephone cards as a collector's item.

A crucial requirement in this regard is to issue cards featuring designs that are attractive to users. NTT has granted regional organizations the right to design and issue their own cards. This effort is aimed at stimulating card demand by issuing cards that meet the needs of each local area.

Another important aspect of the sales promotion activity is to cultivate and stimulate the interest of collectors. Positive efforts are being made to provide information for preparing catalogs, magazines, newsletters and other literature on telephone cards. NTT is also trying to create a favorable environment for collectors by making it possible for them to provide information on telephone cards through the CAPTAIN system. Telephone card clubs have been organized throughout Japan to serve as a place where collectors can exchange information.

4.5 Distribution Strategy

NTT has approximately 1,800 sales offices located throughout Japan. This number was nowhere near large enough to handle sales of an item like telephone cards, which are close to being a daily necessity. This made it necessary to undertake the development of new distribution channels.

The first step was to develop a network of sales agents, focusing primarily on retial shops at train stations, bookstores, coffee shops and hotels, where public telephones are installed.

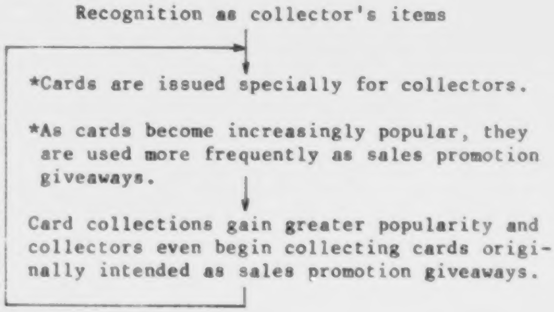
Work is now under way to install card vending machines in the vicinity of public telephone booths. Approximately 4,000 machines are now in place. Card sales are especially brisk in the downtwon areas of large cities. One machine recorded card sales worth ¥6.80 million in one month.

Steps are also being taken to set up sales channels targeted at collectors. The 72 NTT service centers located around Japan try to stock cards from as many regions of Japan as possible, in addition to the cards issued in their local area. In this way they can respond better to collectors' requests.

5. ROLE AND PARTICIPATION OF USERS IN SALES PROMOTION

One of the biggest factors behind the success of Telephone Card is that they allow users to attach their own personal significance to the cards. For instance, in planning and manufacturing a card users are free to reflect their own ideas in the Design Card. Another example of this is the recognition that cards have received as collector's items, which is totally unrelated to their function in facilitating telephone operation.

The impact of their recognition as collector's items can be illustrated in the following flow of events.



Recognition as collector's items

*Cards are issued specially for collectors.

*As cards become increasingly popular, they are used more frequently as sales promotion giveaways.

Card collections gain greater popularity and collectors even begin collecting cards originally intended as sales promotion giveaways.

In the midst of this self-propagation process, NTT has merely provided the means for achieving these activities. What NTT must do in the days ahead is to take steps to prevent the popularity of telephone cards from becoming merely a passing fad. This will involve creating an environment in which various telephone card applications establish a permanent niche in the social and cultural landscape.

6. CONCLUSION

As explained in the foregoing sections, NTT's telephone cards have been enormously successful and are quickly becoming an important new source of revenue for the company. A major factor behind this success has been the positive commitment by users to the second and third product concepts, which has worked to spur on the self-expansion of telephone cards.

This poses a question for NTT concerning the first product concept, which is to facilitate convenient use of public telephones. Are there any steps that NTT can take to enhance the product value of telephone cards in terms of making it easier to operate public telephones?

Studies are now under way to develop new telephone cards that will provide an effective answer to this question. These include a telephone card that can be used to call certain designated numbers and a telephone card that allows the call charges to be billed to the called party for certain specified numbers. In the information society the public telephone will serve as an information terminal for all to use while the telephone card will provide individualized privacy. The question is, how to commercialize and integrated these two products. Herein will lie the springboard for the next dramatic growth of telephone cards in the years ahead.

CATCH 22:
A CASE STUDY OF HAWAIIAN TEL COMPANY

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1. Abstract

Hawaiian Tel Company finds itself in a "Catch 22" situation. On the one hand, Hawaiian Tel views competition as an opportunity to make the transition from being purely a communications utility to an aggressive, market-driven, competitive corporate entity. On the other hand, the company has an obligation to the socially vulnerable to maintain high-quality service at the lowest possible cost. These two conflicting goals are examined to determine what Hawaiian Tel is doing to deal with this Catch 22.

2. INTRODUCTION

Hawaiian Tel was granted a rate increase by the Public Utilities Commission for which a request was filed in March 1985 which will help to increase its intrastate revenues. This rate increase, which took effect May 1, 1986 raised local basic residential telephone rates between 24 and 39%. Yet the company finds itself in a "Catch 22" situation. Hawaiian Tel expects to make $53 million in profits for 1986 from an 8% increase from last year and does not anticipate any request for rate increase in 1987 for its regulated business (1). Total revenues were reported at $440 million or an 11% increase from 1985 and a 14% return on investment. The company cites its healthy financial condition of its non-regulated business (such as business telephone systems, residential telephone equipment sales, its international operations, and the securing of large contracts such as the $112 million contract from the Department of Defense) as an example of its competitive character (1a). It is caught between its previous monopoly operations and the general push from the Federal Communications Commission (FCC) for deregulation with the aim of making the industry more competitive. This involves a significant change in Hawaiian Tel's planning process, its corporate culture and its managerial operations. On the one hand, the company views competition as an opportunity to make the transition from being purely a communications utility to an aggressive, market-driven, competitive corporate entity. On the other hand, the company has an obligation to maintain high-quality service at the lowest possible cost to the socially vulnerable. The company finds that it cannot do both. Thus, the purpose of this paper is to examine the relationship between these two conflicting goals and to determine what Hawaiian Tel is doing to deal with this situation.

In finding solutions to this Catch 22, the analysis takes into account social costs and benefits, which focus on externalities. The effects on production and economic efficiency of the macro-economy of the state and the distribution of welfare are also examined. As such, there are costs and benefits which have to be weighed, keeping in mind the impact on business and residential users and their welfare gains and losses.

3. EXTERNALITIES

Investment in telephone facilities involves certain externalities. That is, there are both social costs and benefits of telephone network expansion and modernization (2). The cost of telephone technology involves economies of scale. Expanding and modernizing the network reduces the social costs of supplying service to existing users of the network. The benefits involve increases in each user's welfare as more users gain access to the network.

Adding a new user to the network typically creates an external benefit for other users, some of whom derive greater value from their telephone by being able to call, or to receive calls, from the new user. Telephone expansion that permits additional users to be connected to the network leads to a net social gain greater than that which accrues to those who already have a telephone. Future users experience these externalities as well because current expansion and modernization extends the network and makes it more efficient.

4. WELFARE EFFECTS

The distribution of welfare effects depends on whether network expansion and modernization is being developed primarily for public and private business users or principally for residential users. Moreover, when public and private systems are provided, the distribution of welfare effects can become more equitable. Emphasis on public systems can have welfare effects because services become available to low income users as well as those living on fixed incomes (i.e., retired persons). When such conditions exist, the system has a positive effect on other sectors. It improves the production and the efficiency with which markets and organizations function and contribute to social organization. The degree to which other sectors are affected reflects two states. Firstly, positive externalities are easy to recognize when telephone access is high and low cost communications are pervasive. the other state is negative when telephone access is low and the cost of communications is high.

The effects of these two externalities become clear when viewed from an information perspective. The telephone performs a valuable service as a means of transmitting information. Modern telephone systems have significantly reduced the cost of transmitting information over space and time. The flow of information that is current and timely facilitates economic and organizational decision-making. Thus, the inherent efficiencies of information flow in more innovative telecommunications systems permit cost-efficient communications, for business, government and individuals.

Conditions that lower the cost of acquiring information are of particular importance when there are those in society who have no access to the telephone system. These conditions lead to disparities between the information haves and the information have-nots, which increase when the existing telephone system quickly becomes obsolete and information transmission becomes inefficient and costly. This makes for a situation in which both the quantity and quality of available information is frequently deficient (3), in which case goods and services markets emerge as poor providers of information. Furthermore, when markets are unstable and rapid structural changes take place, then information becomes unreliable, uncertainty grows and makes economic and administrative decision making problematic. The solution for such conditions is information at affordable costs and information that is easily accessible.

5. COST CHARACTERISTICS

The costs associated with network expansion and modernization depend greatly on two factors. One factor is the local switching and transmission technology. The other is associated with the supply of local telephone services — both basic and enhanced. These costs are embeded in the switching capacity of a local central office and the trunking capacity that connects local offices together. The cost associated with the local loop is independent of telephone usage.

5.1 BANDWIDTH REQUIREMENT COST

Present markets for telephone services are generally characterized by high-capacity related equipment costs and very low traffic costs. These latter costs are related to the variances in usage levels. Aside from the equipment dedicated to serve each user, nearly all the traffic costs associated with local telephone service are caused by capacity provision or bandwidth.

In terms of transmission speed (i.e., the circuit hold time), higher bandwidths greatly increases the amount of information that can be sent through a single channel at any one time. The lower the amount of time required to hold a circuit, the lower the cost for telecommunications. Therefore, the higher the bandwidth, the greater the information carrying capacity of a channel and the faster the information transmitted. These efficiencies result in a reduction in the overall cost of handling information.

Hawaiian Tel is confronted with the selection and provision of bandwidth in its future operations. Within an ISDN environment, bandwidth will become more of a commodity, and users will pay for it according to their volume usage. Users will be able to obtain greater bandwidth that will allow them to adapt services to meet their specific needs for faster and more reliable communications. These needs, coupled with the expansion and modernization of the network, will stimulate the use of more state-of-the-art equipment to take advantage of the inherent efficiencies.

5.2 NON-TRAFFIC SENSITIVE COSTS

Hawaiian Telephone has lost its monopoly of supplying consumer equipment. Inside wiring for single-line telephone customers is now deregulated (as of January 1, 1987) — installation, maintenance, and repair of inside wiring is now handled for a fee or by a maintenance agreement contract (4). Inside wiring for multiline customers has been deregulated since December 1985. That will be affected by the provision of shared-tenant services as landlords and owners of homes and office buildings install their own inside wiring. Customer premises equipment (CPE) in the U.S. has been deregulated and no longer figures directly in the cost of access. Any additional physical facilities required for access today are the inside wiring, the outside plant (including the local loop and interoffice trunking cables) and the central office switching equipment. The capital expenditures for these facilities are the incremental costs of accommodating new users in the network. The cost of access is a common cost; all users share this cost. In fact, the costs associated with providing access are totally independent of whether the user actually makes or receives calls. The costs of access are totally non-traffic sensitive (NTS). They are based on the additional access lines or trunks in the network. The additional lines result in an increase in the overall level of capacity demand in the network. From a technical perspective, the addition of access lines adds to the cost of providing local telephone service. Hawaiian Tel incurs additional construction costs for the wire, cable and associated plant facilities. At the same time, the addition of more access lines places more demand for capacity on the network. These NTS costs are incurred by Hawaiian Tel because it is responsible for maintaining network integrity. This makes the company vulnerable to competition at the high end of the market.

5.3 TRAFFIC SENSITIVE COSTS

Actual use of the telephone network also requires equipment for switching and carrying calls. These traffic sensitive costs will depend primarily on the valuation users place upon the network. Users express their valuation of the network through their volume of calls and the services they subscribe to. This is referred to as option demand. In other words, when users subscribe to telephone service, they are purchasing an option to make and receive calls. At the same time, they are also exercising an option to subscribe or not to subscribe to certain services beyond the basic service provided over the network.

6. EXTERNAL FORCES CHANGING HAWTEL

The U.S. telephone industry is continuing to undergo a transition. Technological forces have brought about structural pressures for change in the corporate culture of Hawaiian Tel, in addition to the deterioration of its monopoly status.

The major forces of technological innovation, namely the convergence between computers and telecommunications, and the FCC's encouragement of competition have led to the reversal of many long-standing assumptions about the necessity and validity of maintaining a natural monopoly which telephone companies in the U.S. had held in the past. The marketplace has become the main mechanism for governing the telecommunications industry. Telephone monopolies are being eroded. Driven by technology, networks, products, and services, the telephone company, cable television and computer companies (to name just a few) are advancing towards the same markets, the same customers and shared revenues. Product and service boundaries are fast dissolving. Geographic markets are less insulated than in the past. This has intensified competition within and among industries. Industries, whose relationship in the past was distant or unrelated, now confront each other as direct competitors. This is more so where there exist viable substitutes for local services such as cellular systems which can deliver high-quality voice calls.

The economies of scope and scale that telephone monopolies once enjoyed appear to be diminishing compared to overall market size. As such the rationale for natural monopolies is fast disappearing. Telephone companies in the U.S. are being encouraged to compete freely in newly deregulated markets, thus expanding their new services. In the wake of these technological and structural changes, Hawaiian Tel has reevaluated its own operations. The company has been investing in modernized equipment, expanded plant facilities and conversion of its managerial practices to fit-in with the new corporate culture that has evolved.

7. INTERNAL FORCES CHANGING HAWTEL

This new corporate culture is largely being determined by its parent company, GTE. With the divestiture of AT&T, GTE is exercising more control over its subsidiaries, with decisions relayed from Stamford, Connecticut. Nowhere is this more evident than in GTE's standing policy of requiring all its local operating companies to incorporate mandatory usage-sensitive tariffs for basic service. The intracorporate push to convert central office switching facilities from analog electromechanical to digital electronic switching will make way for optical fiber technology and eventually for ISDN. This loss of self-determination concerns state officials who fear that Hawaii's best interests may suffer as a result of overall corporate strategy. Thus, Hawaiian Tel is caught between conflicting demands of the HPUC-protected consumer and the corporate parent.

Making the transition from safe, regulated profits to risky, competitive markets, and from being a stodgy, regulated utility to a dynamic market-driven corporate entity is not an easy task. Companies such as the GTE System that are characterized by highly bureaucratic processes are having difficulty in adjusting to a competitive market. An indication of this difficulty is GTE's merger with United Telecommunications for its Sprint long distance operation (5) and the joint venture with Siemens AG of West Germany for its transmission systems operations in the U.S. (6).

According to a Wall Street Journal article (2/13/86), GTE has been suffering from management difficulties. Analysts and industry observers expect the company to focus more attention on its local telephone operations (7). It is in the area of these operations that GTE has been able to obtain steady earnings which have kept returns on equity around 15% for the past five years. GTE's efforts to diversify its operations in unregulated services have been at best unpredictable, despite large investments. Local telephone companies were responsible for 98% of

GTE's $3 billion operating earnings in 1985 before a $2.1 billion dollar pre-tax write-off had to be taken because of the mergers (8). GTE is heavily dependent upon its local telephone companies and, as a result, is focusing on tighter control over them.

The coordination of both the U.S. Telecom and Siemens joint ventures is crucial to GTE's ability to succeed in a limited way in a competitive telecommunications market. With these two new ventures, GTE no longer has outright control over its long distance and transmission systems operations. Moreover, Siemens has been successful in entering the RBOC market for public switching business in the U.S. (9) which now stands challenged by FCC's ruling. GTE, therefore, has begun to focus more attention on its local telephone operations.

8. THE TECHNOLOGY PUSH FOR HAWAIIAN TEL

8.1 SYSTEMS PLUS SERVICES

Most people assume that the ills of the telephone industry in the U.S. are caused by the deregulation policy, but they are not entirely so. Some of them are related to FCC's interpretation of the policy. As an outcome of its Computer II inquiry, the FCC deregulated enhanced communication services as well as all telecommunications equipment, known as customer premises equipment. To accommodate this change, Hawaiian Tel transferred 650 of its over 4,000 employees to a new deregulated division of the company, referred to as Systems Plus Services, to handle the sales and services of telecommunications equipment. Due to its historical position in the Hawaiian market, the company has enjoyed the advantage of terminal equipment supply. Hawaiian Tel claims to have captured 80% of the PBX/Key System market and 90% of the residential single-line equipment market (10). However, it is not known what Hawaiian Tel's share of these markets of new terminal equipment under deregulation will be. According to the company, telecommunications equipment sales account for 15% of the company's annual revenues. Hawaiian Tel's regulated business makes up about 60 to 70% of its total business (11).

Already the FCC has launched a third inquiry redefining the regulatory requirements set in Computer II with Computer III. This latest round of inquiry is an attempt to get rid of the separate subsidiary requirement for dominant carriers in providing non-regulated activities. As of now the cost of providing service is separated from the cost of supplying equipment. This unbundling of costs has forced movement away from flat rates and toward cost-based pricing structures.

8.2 LOCAL GATEWAY

Another major change that has affected the workings of the company has been competition in interstate toll traffic. Hawaiian Tel lost its interstate traffic and got reduced to a local gateway or provider of the network for interstate toll business. The GTE/Justice Department Consent Decree gave GTE legal clearance to acquire Sprint in 1983, thus, Hawaiian Tel -- along with the other GTE operating companies -- is restricted from directly providing interstate toll and private-line services. Agreements were made with AT&T to lease Hawaiiian Tel's toll switching facilities. This was a dramatic change for the well-established corporate culture of Hawaiian Tel, which for many years had an unchallenged monopoly over interstate toll traffic. From 1931 to 1984 it had shared in the profits from this area of business with AT&T and with the local company linking a particular city on the mainland. The loss of this revenue meant further reduction in the possibility of subsidizing local service. The company now receives only the charges associated with leasing its interstate toll switching facilities.

In its 1985 annual report, Hawaiian Tel reports its interstate toll revenues at $75.7 million, down from $88.1 million from the previous year. This loss in revenues, however, was made up by $35.8 million in revenues received from leasing its toll switching facilities, $86.6 million received from access service charges (12).

Currently in Hawaii, there are at least five other carriers of interstate toll service competing fiercely for what was once Hawaiian Tel's market. Companies like AT&T, MCI, US Sprint and local companies like Long Distance/USA, NewTel and VIP Connections provide interstate toll service in Hawaii. All are permitted to tie into Hawaiian Tel's switching facilities; they also pay an access fee for usage of these facilities.

Hawaiian Tel will have to provide equal access to all interstate toll carriers, which will enable toll customers to make long distance calls through non-AT&T carriers as easily as accessing AT&T. Hawaiian Tel is phasing in equal access in Hawaii between 1986 and 1992. By the end of 1987, Hawaiian Tel anticipates 92% of its residential and business customers will have equal access. Some areas of Hawaii will not have equal access until as late as 1992 when Hawaiian Tel's local exchange switching centers have been fully converted to digital, computerized switching. When this is done, it may be possible to phase out interisland toll calls from the control of Hawaiian Tel when equal access becomes easier for competing carriers. This means that many interconnect companies will be able to benefit further and offer the service at competitive rates.

8.3 PACIFIC BASIN EXPANSION

Hawaiian Tel is also placing more emphasis on expanding its Pacific Basin operations which presently bring in $30 million in revenue annually. Hawaiian Tel's Pacific operations include the ownership of telephone companies in Saipan, Tinian, and Rota in Micronesia, the opening of a sales office in Manila, and its international long distance service. The company hopes to sell its products/services and expertise in the Pacific region.

Its telecommunications operations in Micronesia constitute a modern, fully digitalized system in terms of switches, microwave radio system, underground facilities. This follows a major overhaul of the infrastructure available in those islands.

8.4 COMPUTERIZATION AND MODERNIZATION PROGRAM

Changes within Hawaiian Tel and within the industry have forced the company to speed-up its modernization plans. The company finds that changing patterns in customer demand are accelerating the need for it to invest substantially in new switching and transmission facilities. Hawaiian Tel spends approximately $100 million per year on new equipment/facilities. The company has a total capital investment of $1.3 billion. The capital budget for 1986 was estimated to be around $98 million, of which 71% (or $69 million) will be used to expand facilities and services on Oahu. The remaining 29% of the budget expenditures will go toward the Neighbor Islands of Hawaii.

The existing fiber optic system was expanded in 1986. Hawaiian Tel anticipated that two new fiber optic systems will be in service as well as eleven new computerized switching centers will be installed. There are now a total of 26 fiber optic systems in operation on Oahu, two on Maui and one on Kauai. Eleven new computerized switching centers are expected to be operational, eight on Oahu, two on Kauai and one on Maui, with seven more expected in 1987. Presently, approximately 70% of all customer lines are linked to digital, computerized switching centers. Computerization and modernization programs will allow Hawaiian Tel to reduce its overall operating costs. Upgrading the network from antiquated analog equipment to digital equipment will lower the cost of maintenance coupled with the developments of integrated circuits and miniaturization which have lowered the cost of digital switches. (See Chart I) Developments in chip technology alone have allowed reductions in office space and land requirements. Hawaiian Tel owns 179 properties statewide and most of these properties may not be needed and can be sold. The upgrading to digital equipment has reduced labor-intensive jobs and allowed cutbacks in its workforce. The company is relying on reducing its labor through attrition. The annual payroll is currently $133 million for 4,310 employees (13). These trends are likely to continue. One hundred percent of the central offices will be digital by 1991. The company estimates that, by 1990, $525 million of its total capital budget will go toward its computerization and modernization programs.

9. HAWAIIAN TEL'S PUSH TOWARD ISDN

Externalities both positive and negative are undoubtedly important in developing new types of networks for services such as Integrated Services Digital Network (ISDN). The positive externalities from basic telephone service at present are not large despite Hawaii's high teledensity. On the other hand, the positive externalities from enhanced services are ample.

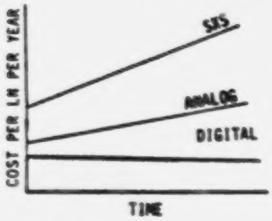
There are generally three reasons why Hawaiian Tel is moving to ISDN. One is to reduce the capital and operating costs of providing communications services by increasing the efficiencies of a modern facility. The second is that ISDN is a means of developing new revenue sources. Earnings growth will come from the network since it is very likely that the regulated local exchange network will remain a monopoly. ISDN is really a strategic push for new network-intensive services that will keep present as well as future users on the network thereby maintaining and adding to the revenue base. Finally, ISDN is a way for Hawaiian Tel to reduce its vulnerability to competition without incurring losses in its existing revenue base. Hawaiian Tel intends to achieve these goals by exploiting the potential of ISDN. This involves introducing new enhanced services, repackaging traditional services, (i.e. enhanced centrex and enhanced custom calling) expanding services and offering price flexibility through bundling and unbundling of rates (14). The cost reduction and revenue enhancement strategies are symbiotic; the implementation of one will enhance the other. In total, it is an opportunity for Hawaiian Tel to make the transition from being purely a communications utility to an aggressive, market-driven, competitive corporate entity for different forms of networks covering voice and data transmisison. It opens up opportunities for entering the market with teletex/telemonitoring (alarm, utility metering, energy management), videotex, home banking, home shopping, electronic yellow pages, packet-switching, teleconferencing (slow-screen, compressed video) to name just a few. Many of these services will be capable of being mixed and accessed simultaneously or even in conference configuration. (See Tables 1 and 2)

10. TOWARDS COST-BASED SERVICES

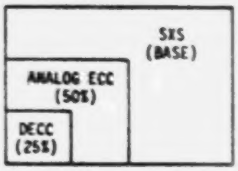
In consequences of all these changes, the price of the basic service, over which Hawaiian Tel continues to exercise a monopoly, will suffer from higher tariffs. Cost-based services without any cross subsidy will be implemented due to which the consumer will stand to lose rather than the supplier of the service. This is true because the company being a monopolist, is not required to operate at cost-efficient levels of production. In other words, the cost of new technology and equipment is being driven down by scale economies and specialization, but this will not benefit the user. For instance, satellite

CHART I

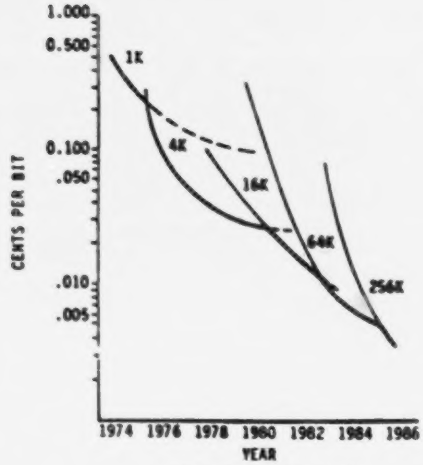
ADVANTAGES OF DIGITAL EQUIPMENT



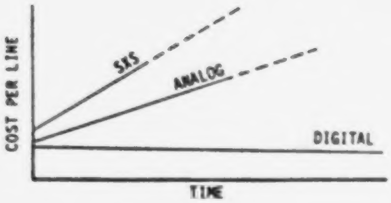
MAINT COST COMPARISON


SXS
(BASE)
ANALOG ECC
(50%)
DECC
(25%)

FLOOR SPACE REQUIREMENT COMPARISON



COST FOR VLSI CHIPS



SWITCHING EQUIP COST COMPARISON

TABLE I

USER APPLICATIONS FOR BUSINESS

SERVICES	DATA RATE	ISDN CHANNEL TYPE		BROAD BAND CHANNEL
		B	D	
B.1 Telephone	8, 16, 32, 64 KB/S	x		
B.2 Interactive Data Comm	4.8 - 64 KB/S	x	x	
B.3 Electronic Mail	4.8-64KB/S	x		
B.4 Bulk Data Transfer	4.8-64 KB/S	x		
B.5 Facsimile/Graphics	4.8-64 KB/S	x		
B.6 Slow Scan/Freeze Frame TV	56-64 KB/S	x		
B.7 Compressed Video Conf.	1.544 MB/S			x (PAR)

TABLE II

USER APPLICATIONS FOR THE HOME

SERVICES	DATA RATE	ISDN CHANNEL TYPE		BROAD BAND CHANNEL
		B	D	
R.1 Telephone	8, 16, 32, 64, KB/S	X		
R.2 Alarm:				
Smoke, Fire; Police; Medical	10 -100 B/S		X	
R.3 Utility Metering	0.1 - 1.0 KB/S		X	
R.4 Energy Management	0.1 - 1.0 KB/S		X	
R.5 Interactive Info Svcs (Videotex); Electronic Banking; Electronic Yellow Pages; Opinion Polling	4.8 - 64 KB/S	X		
R.6 Electronic Mail	4.8 - 64 KB/S	X		
R.7 Broadcast Video	90 MB/S			X
R.8 Switched Video	90 MB/S			X
R.9 Interactive Video	90 MB/S			X

communications is cost-insensitive to distance, the cost of earth based equipment is declining with greater on-board power of satellites. Likewise, the cost of digital switches and fiber optic cables will be declining with greater competition in the supply and greater standardization of integrated services.

There will also emerge externalities or indirect benefits to the provider which will not always be known to the consumer. The PUC will then be obliged to keep closer vigil over cost-based prices. While competition automatically drives prices toward cost, this is not true of a monopolist supplier when other channels of its monopoly control have been dwindling or denied. This is particularly important when the regulated local exchange network will more than likely remain a monopoly. The loss of revenues to Hawaiian Tel will be recouped by using cost-based tariffs for local service. What this implies is that if prices are to remain low then Hawaiian Tel will have to exercise greater control over its cost structure and make every attempt to drive down costs. But Hawaiian Tel is not obliged to do so since it is the monopoly supplier of the service in Hawaii and price elasticity of demand for telephones is virtually inflexible. This is especially true of business users as well as for certain classes of residential users who cannot cut down their demand to any appreciable extent. The claim that prices will reflect the true cost of supply need not hold good under such circumstances.

Hawaiian Tel's stand in regards to cost-based services is that it needs to ensure minimum revenues to cover its capital costs, its cost of debt servicing and its losses from interstate revenues. Since inflation is being held down at 4.5% over the last three years, labor costs will not be a major component of future increases in tariffs. Depreciation costs, operating expenses and the cost of borrowing funds will be the major items to be set off against future hikes in tariffs. As the company installs new computerized equipment and the pressures to lower costs and increases in productivity in the supply of services are operable, automatically economies of scale will ensue. There will also be externalities to the company in the form of more automated equipment, which will reduce the need for extra labor, reduce the need for expanding office space or training of existing workers. The new tax code which begins operating in 1987 will provide substantial tax write-offs to the company during the transition period.

With greater concentration on local and interisland traffic, Hawaiian Tel's managerial system can be simplified and research and development can be directed to the supply of newer forms of network-intensive services such as data transmission, enhanced centrex and videotex (to name just a few). The leverage of specialization in services triggers economies and thereby enhances the scope for higher revenues. Therefore, the company's demand for increased revenues in the future cannot be fully justified on economic grounds.

11. INTRODUCING USAGE-SENSITIVE TARIFFS

It may be possible for Hawaiian Tel to introduce usage-sensitive tariffs (UST) to ensure a rate of return that will cover its increased capital costs. Since there is no substitution elasticity of demand for telephone service, price elasticity alone will make it feasible for Hawaiian Tel to charge on the basis of usage.

Usage sensitive service (USS) will enable business users to tailor their needs to peak load pricing in order to offset increases in usage. At the same time, residential users will be more conscious of their need to use the service. On the whole, the load on Hawaiian Tel's equipment will be reduced without loss of welfare to the community.

In 1983, Hawaiian Tel filed with the HPUC for approval of USS. The company's proposal called for mandatory statewide implementation of usage sensitive rates. Whereas other states, not under GTE's purview, have some form of measured service and offer it on an optional basis, Hawaiian Tel's proposal meant that the consumer in Hawaii would have no choice but to pay for basic service on a usage-sensitive basis.

This movement toward mandatory USS is a reflection of the overall corporate philosophy of its parent GTE in its attempt to have 90% of its system converted to usage sensitive tariffs by 1990. GTE maintains an on-going corporate policy to push for mandatory USS in all of its local operating companies as a way of replacing the cost burden of local telephone service directly on the user.

In May 1985, the HPUC rejected Hawaiian Tel's proposal for USS. The commission did not reject the concept of USS but, instead, rejected the proposal for its implementation. Indeed, the commission and the Consumer Advocate did see merit in USS but were concerned that an abrupt change form flat rates to mandatory USS tariffs may have unintended welfare effects and an undesirable impact. Particular concern was raised with the impact on the physically disabled, the elderly, small businesses, non-profit public service organizations and low income telephone users. The HPUC and the Consuemr Advocate made it clear that telephone service in Hawaii is considered a public good.

To introduce USS, Hawaiian Tel will require equipment to measure usage and will need to generate sufficient revenue to cover this additional investment. Often measured prices are capable of creating hardship for the low income groups who at present rely on using the telephone to obtain information as and when they please. Under USS, they have to restrict their calls to need-based ones only.

Access charges add to this hardship. These have been levied on customers for interstate toll service. Large corporations can avoid such charges through bypass systems, but the residential and small business user will pay the higher tariffs of cost-based pricing. The access charge is a burden on economic welfare because it has to be paid irrespective of whether toll calls are made or not. Hawaiian Tel has already planned to extend this charge even to intrastate toll traffic on each island for access to the local loop. The company wants to keep local rates on each island low to prevent the emergence of bypass systems and will use the access charge to compensate for the local calls. This involves two sets of charges: one for interstate and another for intrastate. Single-line business and residential customers have already been paying the interstate access charge -- $2 per line -- in addition to their basic monthly local and toll charges.

12. INTRODUCING COST-BASED TARIFFS

As of May 1, 1986, new telephone tariffs for basic service took effect. These tariffs are geared to reflect the cost of providing service. Rate increases for all islands in the state were introduced since the value of service concept is eliminated. At present, Oahu customers pay more for basic service than the Neighbor Island customers because of the equity concept.

Presently, monthly rates for single-line residential customers on Oahu is $14.10, compared to $12.75 for the island of Hawaii, $12.20 for Maui and Kauai, $10.60 for Molokai and $9.65 for Lanai. Business customers are subject to the same concept. Single-line business customers on Oahu pay $34.80, compared to $25.75 for Hawaii, $23.70 for Maui and Kauai, $19.25 for Molokai and $16.95 for Lanai. (See Table 3) This means that residential and business customers on Oahu get more value out of their subscription and positive externalities because there are more people on Oahu with whom communication is possible at no extra cost.

Any reduction in Hawaiian Tel's business will eventually entail higher tariffs for the consumer to whom the higher costs will be passed on. However, as a monopolist, the company should be able to arrange its tariffs in an ascending order of elasticities of demand in such a way that the highest price is charged to the least elastic market and the lowest to the most elastic market. In that way, the company can protect its total revenue without destroying equity in its system. Again, as a monopolist in the local service domain, it is possible for Hawaiian Tel to use price discrimination by charging higher tariffs to those who need and want the added value of enhanced services (as is done by the airlines). The service, in general, is the same as either of transporting customers from point A to point B or transmitting messages between two points. There are, however, those who need the benefits of value-added services like businesses, banks, financial investment firms, universities and certain classes of residential customers, and those who just need simple communications like POTS ("plain old telephone service"). This will help Hawaiian Tel to spread the benefits and welfare effects to larger groups of persons without loss of revenues. However, this concept can only be used in local service and not in toll service in which competition is already growing.

The disparity in tariffs from island to island is the result of Hawaiian Tel's efforts to price its services more closely in line with the cost of providing the service. It is likely that such tariffs would remove all consumer's surplus from telephone service. It would render basic communications a luxury for residents of those islands. Businesses will think twice before starting new enterprises on these islands and this will reduce employment opportunities for their residents for no fault of theirs. It appears then that usage-sensitive tariffs will not result in equity, but will help the company generate additional revenues with comparative ease due to the inflexibility of elasticity of demand on the Neighbor Islands.

While it is true that enhanced services are necessary for Hawaiian Tel to move to ISDN, the burden of this environment should not be solely borne by those customers who need only voice-based services.

Moreover, since divestiture, depreciation schedules have been speeded-up. This has allowed quicker investment in new fiber optic cables and digital switches. The short-term effect involves higher local tariffs. There is some question also of whether the present modernization program is beyond what consumers in Hawaii demand. It appears as if the relatively protected monopoly market will subsidize the market where competition prevails. However, in the absence of adequate data on the benefits and costs of usage sensitive service, it is not possible to draw accurate conclusions.

13. LIFELINE RATES

In Hawaii, concern over recent rate increases has spurred a growth in consumer activism. Requests for rate increases are meeting with opposition. Concern over telephone tariffs has also been expressed by PUC, Hawaiian Tel, Consumer Advocate, consumer groups, State Executive Office on the Aging, State Department of Social Services and Housing, and State Department of Health. The focal point of concern involves socially vulnerable groups such as the elderly, the low income, the physically disabled, and those consumers living on fixed incomes. The result has been the implementation of lifeline service in Hawaii which took effect June 1, 1986.

Strangely, though, Hawaiian Tel's lifeline service provides for only two categories of

Table 3

Basic Monthly Local Telephone Rates for Hawaii
Hawaiian Tel

Residential: Individual line

	Old Rates (A)	New Rates (B)	% Change (C=$2.70/A)	Orig. Prop. Rates
Oahu	$11.40	$14.10	23.7%	$20.50
Hawaii	10.05	12.75	26.9%	20.05
Maui	9.50	12.20	28.4%	17.15
Kauai	9.50	12.20	28.4%	18.60
Molokai	7.90	10.60	34.2%	17.30
Lanai	6.95	9.65	38.8%	11.90

Business: Individual line

	Old Rates (A)	New Rates (B)	% Change (C=$3.55/A)	Orig. Prop. Rates
Oahu	$31.25	$34.80	11.4%	$48.20
Hawaii	22.20	25.75	16.0%	37.15
Maui	20.15	23.70	17.6%	32.25
Kauai	20.15	23.70	17.6%	34.20
Molokai	15.70	19.25	22.6%	29.05
Lanai	13.40	16.95	26.5%	21.25

Business: Rotary line

	Old Rates (A)	New Rates (B)	% Change (C=$3.55/A)	Orig. Prop. Rates
Oahu	$39.70	$43.25	8.9%	$64.15
Hawaii	28.10	31.65	12.6%	48.65
Maui	25.75	29.30	13.8%	44.35
Kauai	25.75	29.30	13.8%	44.45
Molokai	20.15	23.70	17.6%	37.15
Lanai	17.20	20.75	20.6%	30.10

Business: PBX line

	Old Rates (A)	New Rates (B)	% Change (C=$3.55/A)	Orig. Prop. Rates
Oahu	$51.25	$54.80	6.9%	$64.15
Hawaii	36.30	39.85	9.8%	48.65
Maui	32.80	36.35	10.8%	44.35
Kauai	32.80	36.35	10.8%	44.45
Molokai	25.65	29.20	13.8%	37.15
Lanai	22.10	25.65	16.1%	30.10

Source: Hawaiian Tel

individuals who are eligible for lifeline service. Persons 60-years-old or older with a total annual household income of $10,000 or less and physically or mentally disabled persons with a total annual household income of $10,000 or less with certification by a doctor of the Department of Health. Persons certified by the Public Welfare Division of the Department of Social Services and Housing (DSSH) under a financial assistance program are excluded and are not eligible. Lifeline did not include general welfare recipients because there was concern by State Legislature over welfare problems. As a result, Hawaii will not qualify for the FCC's lifeline program -- FCC wanted complete coverage of all low income people. Under the FCC's program, states which came up with lifeline rates would qualify to get a lifeline reduction for the subscriber line charges.

In light of this, Hawaiian Tel needs to show more concern for the social impact of rate-making in future rate-hike claims. Although the company has stated (in testimony) that it does not want to take on the role of a social welfare agency, it needs to take on more social responsibility for its actions or at least some awareness of the social implications of its policies.

14. CONCLUSION

Hawaiian Tel is in a period in which it needs to invest in new facilities to keep pace with technology, but it needs to be sensitive to the level of market growth rates. By improving the quality and reducing the cost of telecommunications, these investments will also have substantial positive externalities on users as well as the economy, provided market growth rates are matched by growth of the telecommunications infrastructure. Continued improvement of the telecommunications infrastructure will have the potential of stimulating the development of business heavily dependent on communications and information services, and thus, help Hawaii advance towards an Information Society.

The fact remains that socially optimum allocation of investment resources is a challenging problem for both Hawaiian Tel and for consumers. An investment policy's side effect on income creation can be very significant. Consequently, an analysis incorporating externalities should be undertaken to measure social benefits and costs.

In considering both the equity and efficiency consequences of the company's policy, welfare effects must not be omitted. Telephone service expansion can have several positive effects on production and economic efficiency of the macro economy and on the distribution of welfare. One externality is the declining average cost over a wide range of supplies because as additional subscribers get connected to the system, each earlier subscriber's welfare increases. This is known as an access externality. Being an intertemporal advantage, the density of the telephone system and its penetration become important variables in deciding on whether a rate hike is justifiable or not in terms of social welfare. From the point of view of acquiring information and reducing uncertainty, expanded telecommunications services help economic agents to make rational decisions. This is again an externality that increases the welfare of the user.

In future, rate increases sought by Hawaiian Tel from HPUC may require that the amount awarded be placed in an Escrow account to ensure investment in equipment, which may not be a once-for-all purchase. As the equipment gets added to the company's operations and the company reaches its break-even point, it may be possible to ward off further rate increases. This will depend on the future plans which Hawaiian Tel has for its policy of modernization.

Most strategic planners rely on a snapshot approach to what the future rate of return will be on investment on an annual basis. Unfortunately, key variables like inflation, total capacity, excess capacity and fixed costs keep changing and that means the corporate break-even point also changes. Perhaps what is needed is a motion picture approach instead of a snapshot. This is not easy because aggregate numbers have to be plotted over time. As such there are pros and cons which have to be weighed keeping in mind the impact on business and residential users, and their welfare gains and losses.

Perhaps future rate increases become inevitable in the light of essential new equipment and managerial changes to meet the restrictions imposed by the FCC, but at the same time, Hawaiian Tel will have to become more cost conscious even though it has monopoly power over basic service. Cost efficiency will automatically generate distributional equity and will help promote higher gross state product. The corporate culture of Hawaiian Tel, which has so far been geared to monopoly, has now changed to face the opportunities of competition. But the "Catch 22" remains.

Notes

(1) Lynch, R. (1986, November 18). Hawaiian Tel, with rosy future, will not ask for rate increase. Star Bulletin, p. C-1.

(1a) Berglund, N. (1986, November 18). HawTel won't seek 1987 rate hike. The Honolulu Advertiser, p. B-3.

(2) Leff, N.H. (1984, January). "Externalities, information costs, and social benefit-cost analysis for economic development: An example from telecommunications." Economic Development and Cultural Changes, 32(2), 255-276.

(3) The term "quality of information" follows Nathaniel Leff's definition, which refers to the timeliness, completeness and reliability of information produced.

(4) Kaser, T. (1986, November 16). HawTel preparing customers for deregulation of wiring. The Sunday Star-Bulletin and Advertiser, p. D-4

(5) GTE & United complete merger of LD units. (1986, May 15). Telephone Engineer & Management, p. 41.

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(9) GTE/Siemens joint venture in jeopardy. (1986, May 1). Telephone Engineer & Management, p. 27.

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(12) Hawaiian Telephone Company (1985) Annual Report. Honolulu Hawaiian Telephone Co.

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A STRATEGIC PERSPECTIVE FOR HAWAII'S FUTURE USERS OF TELECOMMUNICATIONS

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The telecommunications situation in Hawaii is similar to that of the rest of the United States, with some notable exceptions. The manner in which current and future changes occur in the construction and operation of telecommunications facilities in Hawaii, and the manner in which the delivery and pricing of telecommunications services develop in Hawaii, will also resemble what occurs nationally. The subjects of this essay are those characteristics of user demands either unique to Hawaii or common to all of the states which may not be given appropriate consideration during the current stages of planning or implementation.

I. Introduction

The predominant characteristic of U.S. telecommunications in the 1980's is the transitional problem of moving from a rigorously regulated, facilities-orientated industry to a less regulated, more market-driven industry. Operating and investing assumptions, heretofore safely relied upon by telco management, users, regulators, and competitors, no longer will ensure quality service, stable rates and the certainty of profits. The transitional problems are causing confusion in the marketplace, and the longer-term problems are perplexing regulators and necessitating revolutionary thinking within the industry.

An analysis of the causes of these changes is not the subject of this paper, but it is noteworthy that once the new technologies of computing data and processing information were in the possession of end users, users started to demand the technological means of interconnecting their advanced facilities in order for them to realize public convenience and economic gain. Concurrent with consumers' clamor for improved means of telecommunications, telecommunications technologies were giving promise of declining costs and an array of new services. Regulators, particularly federal policy makers, concluded that new entrants were needed in the telecommunications industry in order to introduce new and improved services at "competitive" rates. As regulation--the time-honored surrogate for competition--now gives way to some actual competitive influences, earlier established regulatory policies must be reexamined for underlying factual and theoretical support.

The telecommunications industry is in search of long-term strategies to preserve revenue streams, to provide likely prospects of adequate returns, and to create opportunities for growth; so also, users must develop strategies to obtain state-of-the-art technologies at truly competitive prices. Perhaps providers' strategies will merge with users'; perhaps not. De-escalating the regulation of the telecommunications industry should be slower and less pervasive than that of the air transport industry: because telcos assets are greater in value and far less mobile, caution should prevail. But mergers, consolidations, destructive competition in some markets and escalation of certain monopoly pricing practices in other markets loom on the national horizon, and are more probable than not in the Hawaii telecommunications markets.

II. A Brief Profile of Hawaii's Telecommunications Providers

Nearly eighty percent of switched network services on the Mainland are provided by former Bell companies; all of Hawaii's switched network has been and continues to be owned and operated by a single provider--Hawaiian Telephone Company ("HTC"), a wholly-owned subsidiary of GTE. HTC has franchise-like operating rights for all of Hawaii's populated islands in the State, as well as possessing operating rights for interisland services, certain Mainland(CONUS)-Hawaii domestic services, and international services. The 620 square-mile island of Oahu has approximately 80 percent of Hawaii's 1.1 million de facto population, which is laid out in a relatively concentrated population ring around the island. It is an area suitable for efficient provision of telecommunications services, at least from an engineering point of view.

The volume of long distance traffic transported to and from Hawaii by interexchange carriers compares favorably with traffic reports for other inter-LATA and international markets, which fact is principally attributable to the heavy visitor industry and the military operations.

The annual revenues for local exchange services approximated $200 million for 1986; the total revenues for Hawaiian Telephone Company--local services, provision of access to long distance facilities, interisland long distance and international services, as well as unregulated operations, e.g. CPE sales, leasing, and services, construction services, etc.--exceeded $400 million in 1986.

The four major inter-LATA carriers providing CONUS-Hawaii services and some international services are AT&T-C, MCI, US Sprint, and Long Distance USA. There is inter-modal competition, and there are competing civilian earth station facilities serving the CONUS-Hawaii markets. There are at least eight Hawaii-based providers of dedicated channel services to points beyond Hawaii.

III. A Profile of Hawaii's Present Telecommunications Users

Users of Hawaii's telecommunications facilities and services are quite diverse, but are often categorized, as follows: (1) military, (2) civilian governments--federal, state, and local; (3) the visitor industry, (4) other multi-line commercial users; and (5) single-line commercial and residential users. As will be discussed, infra, Parts IV and V, on-going changes in user characteristics will necessitate rejection of market segmentation in the traditional sense.

The military constitutes the single largest market segment in Hawaii having distinctive user characteristics. Generally, the military demands reliability, redundancy, and user control, and satisfies many of its needs by contracting for various specialized facilities. To date, the military has relied heavily on the incumbent carriers serving Hawaii.

The civilian federal, state, and local governmental agencies are comprised of several purchasing entities. Only recently have these agencies exhibited prudent consumerism, becoming active in regulatory proceedings, searching for least-cost alternatives, and relying on competitive procurement practices for services and customer-premised equipment.

It is difficult to generalize, when profiling the visitor industry markets. Some visitor service providers situated in Hawaii such as airlines, car rental agencies, national hotel systems, and tour package wholesalers are oftentimes components of nation-wide companies which, because of their intense competitiveness, are constantly in the telecommunications market looking for the lowest-priced, reliable services. Most components of the visitor industry are experiencing a burgeoning use of data for their own operations. The hotels, as innkeepers, also provide voice telecommunications services for their hotel guests; as such, they are making plans for by-passing either certain of the local exchange's switched network services, or the entire facilities. The visitor industry represents some 33 percent of Hawaii's gross state product.

Table 1 shows the industry groups present in Hawaii and their rank, by measurement of mean telephone usage per line.

Table 1
Characteristics of Business by Industry Group: Hawaii 1982

Industry Group	(a) Number of Firms	(b) Number of Employees	(c) Ranking of Industries by Average No. of Employees Per Firm (b/a)	(d) Rank by Telephone Usage*
Agriculture/Fisheries	207	1,850	9	9
Mining	14	282	3	9
Contract Construction	1,540	19,416	6	4
Manufacturing	863	23,215	2	6
Transportation/Other Utilities	944	28,445	1	1
Wholesale	1,684	17,695	7	7
Retail Trade	6,057	85,817	5	8
Finance/Insurance/ Real Estate	2,883	29,526	8	3
Services	7,091	102,444	4	5
Public Administration				2
Other	372	456		
TOTAL	21,655	309,146		

Sources: Derived from Table 453, page 479. The State of Hawaii Data Book, 1984. HTC Exhibit 201, Hawaii Public Utilities Commission Docket 3423-IV, page 18.

*Measured as mean usage per line.

Transportation services and utilities are the highest users of the telephone, exhibiting their need for coordination in facilitating the exchange and delivery of goods and people. These industries also show the highest average employee count per firm which is entirely consistent with the theory that telephone usage is primarily a function of the size of the firm--the number of employees being one measure of a firm's size. This relationship is not always consistent: manufacturing ranks second in average number of employees per firm, yet it is sixth with respect to telephone usage; the finance/insurance/real estate figures indicate that they are eighth in firm size but third in telephone usage. Health care providers constitute some of Hawaii's largest employers, and they are large users of telecommunications services.

Table 1 reflects the fact both industry structure and the nature of the product/business influences telecommunications usage.

Table 2
Hawaii Business Telephone Use

	Telephone Usage	
	Mean Usage Per Line	Total Use
Firm Size:		
Number of Employees		
0 to 5	+	+
6 to 10	N	N
11 to 20	+	N
Over 20	+	+
Type of Telephone Equipment:		
BPX	+	+
Key	+	+
B-1		
Geographic Dispersion:	N	N
Number of Locations	N	N
1 to 10	N	N
11 or More	+	N

Legend: + indicates a significant effect.
N indicates no significant independent effect.

Source: Derived from Testimony of Hawaiian Telephone Company filed in Docket 3423-IV of the Hawaii Public Utilities Commission, 1984.

Table 2 demonstrates that geographic distribution, as well as number of employees, affects telecommunications use, but such measures give us little, if any, indication of how usage might differentiate itself when alternative forms of telecommunication services are introduced in a competitive market.

New telecommunication technologies offer businesses the opportunity to increase productivity. Table 3, read together with Table 1, suggests outdoor-oriented businesses have a high interest in cellular, which is well suited to their needs, suggesting a user characteristic of "mobility." High interest shown by the ground transport, agricultural, and construction industries suggests strong substitution potential for cellular over more traditional modes of mobile telecommunications.

Table 3
Potential Cellular Subscribers Interest (at a Reasonable Price) Within Various Standard Industry Classifications (SIC)).

SIC Group	% of Business Interest
Agriculture/Forest/Fishing	55%
Construction	54%
Manufacturing	35%
Transportation/Communication/Utilities	51%
Wholesale	44%
Retail	40%
Financial/Insurance/Real Estate	40%
Services	47%
Government	42%

Source: HPUC Docket 5180
Comment: High Interest Across Small Groups

Multi-line users, particularly large firms with PBX's, often need data, in addition to voice services. Some industry groups, such as finance/real estate/insurance are likely to exhibit far greater data needs than others. Airlines and hotels also exhibit data needs for reservations systems. HILANS, the new metropolitan area data networking system recently put into operation by Hawaiian Telephone Company in downtown Honolulu, suggests that selective placement of specialized facilities will cause greater differentiation in the types and placement of networks. "Telephone service," as we once referred to it, will be far less ubiquitous in the future. Usage patterns of some new services differ substantially from former usage patterns, causing different stresses on the network and necessitating new configurations in network development (refer, Table 4).

Table 4
New Service User Patterns

Service	Screens/ Pages Per Day	Calls Per Day
Rapid Facsimile 48 kbits	50-100	25-50
Other Facsimile	5-10	3-5
Teletex	4-8	4-8
Videotex	10-25	2-5

Source: Smith, E.A., Walsh, W.A.G. and Wilson, M.J., Telephony. June 14, 1982. p.39.

Hawaii's users of telecommunications services have proven to be quite receptive to new services. Indications are that facsimile was quickly adopted during the past two year period.

Surveys have shown that Hawaii users have adopted the use of electronic mail and data bases at a rate faster than the Mainland, on average. In early 1986, the subscriber count for electronic mail in Hawaii was 1,050; available information for the same time period suggests there are currently about 130,000 subscribers in the entire United States. Given the ratio of subscribers to population, it would appear that Hawaii has a relatively high potential for electronic mail services since it exceeds the national average by about 2-1/2 times. Many third party electronic mail providers utilize a dealer system in which dealers merely resell services.

Electronic mail actually involves a number of types of message forms. Thus, services such as bulletin boards, volume mail and shared lists herald hybrid forms of telemarketing on the near horizon.

If it is assumed that Hawaii has 21,655 businesses and that those businesses account for all electronic mail accounts, then business penetration of the service is approximately 4.8 percent currently. Two limitations must be noted with respect to this projection of penetration: (1) some subscribers are individuals; and (2) it is unclear if a business with several account numbers is being counted as several customers.

Hawaii's tendency to quickly place reliance on these technologies is based on geographic isolation, and users' dependency on the U.S. Mainland and other countries in the Pacific for the importation of information and products necessary to maintain a quality lifestyle. Also, large differences in time zones between Hawaii and other places, and favorable rate structures relative to time differences, such as East Coast-CONUS and Japan, make store and forward a convenient and economical way of handling important transactions.

There is a need to measure the degree of inter-activity of communicators. New services may be looked upon as highly interactive messaging like electronic mail, or minimally interactive transactions such as data base access (primarily used for informational requests). The technologies and network configurations needed to supply these are different than the configuration of traditional telephone networks.

Depending upon the direction and degree of growth in inter-activity, cable television's high market penetration in Hawaii may provide a viable alternative to common carriage for the provision of data base access and other informational uses by businesses either to accommodate growth in demand, or merely as a consequence of lowered regulatory barriers to market entry. The type of network that the cable operators have used in Hawaii in the past (typically, a trunk and branch system), is more easily updated to provide information access than to provide fully interactive services.

Government users (public administration, on Table 1) have many specialized needs, which in turn depend on governments' responsibilities to meet growing citizen demands on government. In a recent workshop conducted for social service agencies, an analysis of word associations revealed that government will find it necessary to have a widely distributed network of telecommunication services in order to conduct its diverse business directly with citizens, as well as to coordinate functions among governmental agencies.

Finally, there is demand for telecommunication by residential consumers. Table 5 provides a comparison of Hawaii and the U.S., according to demographics shown to affect telephone use in other studies. Hawaii differs in several important ways: our educational level is higher, a higher percentage of people are employed, households are larger, and the ethnic make up differs substantially more here than the general U.S. population. It is believed that all of these factors contribute to the higher than average penetration of telephones, but certain socio-economic characteristics are disguised by the high average: (1) Hawaii's lower income relative to the cost of living, (2) the complex relationship between income, household size, and ethnic background, and (3) the stark differences in comparisons of the main island of Oahu with Oahu's neighboring islands.

Table 5
Comparison of Demographic Characteristics Between U.S. and Hawaii Relevant to Telephone

	1980		1985	
	U.S.	HI	U.S.	HI
Median Household Income	$20,473	$21,083	$24,580	$24,800
% Poverty or Below 1/	13.2	9.9	--	--
Total Population (Millions)	226.5	0.96	237.2	1.05
% Female	51.5	48.7	--	--
% With Limitation in Major Activity 5/	14.4	6.5	14.3	4.8
% Urban	73.7	86.5	--	--
% Population Employed	63.8	62.4	--	--
% Unemployed	7.1	4.9	6.7	5.6 3/
% Female over 16 Employed	47.7	57.8	53.0	--
% Female 25-54 Employed	58.6	65.6	70.0	72.1
% Self-Employed (% of All Employed)	6.8	6.9	7.3	8.0 4/
Agriculture (Except Self-Employed)	3.6	6.4	3.2	7.3
Non-Agriculture	89.6	86.7	89.5	85.7
Median Age 2/	30.0	28.3	31.2	29.9
% Over 65	11.3	7.9	11.9	9.0 3/
% "Teenagers" (Aged 10 through 19)	17.9	16.7	15.3	--
% Children (14 and Under)	22.7	22.7	21.8	23.3 3/
Number of Households (Millions)	80.6	0.29	86.8	.32 3/
Average Household Size	2.76	3.15	2.69	3.08
% Female Household Head (No Spouse Present)	10.8	13.0	11.7	--
Male Persons 65 and Older (Secondary Individuals as a % of Families)	1.3	--	1.7	--
% Households (Not Married Couple)	60.8	63.2	58.0	--
Population Other Than White	16.9	65.6	15.7	63.0
Median Educational Level (Those Over 25 Years of Age) 6/	12.0	12.7	12.2	12.8
% High School Graduates	66.5	73.8	73.3	76.5
% College Graduates	16.2	20.3	19.1	23.0
Life Expectancy	73.0	78.0	74.7	77.0
Telephone Penetration (Residential)				
% Urban Penetration	95.3	95.9	--	--
% Rural Penetration	92.0	89.6	--	--

1/ Hawaii figure given is unadjusted for differences in cost of living. If adjusted it becomes approximately 14.4%.

2/ Median age shown as 1985 is actually 1983 figure.

3/ Figure is 1984 data.

4/ Figure is 1983 data.

5/ Federal data may not be comparable to state data.

6/ Figure for Hawaii excludes military.

Sources:

Census data taken from Housing, General Population and Social and Economic Characteristics, 1980 U.S. Census.

Hawaii data derived from 1980 U.S. Census; Hawaii State Data Book, 1983, 1984 1985, and 1986 (pre-publication draft).

Telephone penetration by income is shown in Table 6 and broken out to show the even more dramatic differences between Oahu (our urban center) and the outer islands.

Table 6

Household Income	% Telephone Penetration for Oahu	% Telephone Penetration for Neighbor Islands
Under $5,000	85.75%	77.78%
$ 5,000 - 10,000	90.10	84.87
$10,001 - 15,000	94.24	88.68
$15,001 - 25,000	97.35	95.53
Over $25,000	99.24	97.86
TOTAL	95.84%	91.88%

Source: Special Census Tabulation. DPED Microdata Sample. 1980 U.S. Census.

If the present disparities give cause for concern over the possible social disadvantages, differences are likely to be even more significant in the future as residents experience a growing need for access (with greater associated costs) to a wider array of information services.

IV. Presently Discernible Future Trends

Ten years ago, forecasting the future in telecommunications was thought to be a relatively simple exercise: perform some regression analysis and project the future based on the historical experience. Now we discover that many of the forecasts of ten years ago, while then seemingly easy to make, were well off the mark. Whose crystal ball foresaw equal access; forbearance regulation; competing satellite earth station facilities; competing submarine cables; the complete rebuilding of the local exchange network, etc.? Thus, it is with great trepidation that one discerns a trend from today's telecommunications environment and relies upon it for planning purposes. However, certain areas of current emphasis that will impact the future are clear.

Economic Efficiency. There is less regulation of the economics of telecommunications today than there was ten years ago. Our experience over the last few years should at least teach us to review historical trends with skepticism. It seems safe to state that regulation in the future will be different than it has been in the past. A rate-base, facilities-orientated management mentality is being replaced with what appears, at times, to approach an obsession: economic efficiency.

Economic efficiency is a desirable objective but if it were to become the predominant regulatory goal to the exclusion of other valid objectives, regulatory decisions could be contrary to sound public policy. The craze for economic efficiency is a near-term overreaction to real and perceived threats of competition to the switched network. Experience

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in the past suggests a need to be at least equally concerned with universal access and distributional equity as with economic efficiency.

Market-Driven Pricing. From amongst all of the diverging trends in this chaotic period of change, there is growing consensus that prices need to be more market-driven. One of the arguments for this is that prices will come down, thereby serving to facilitate universal access as well as economic efficiency. However, the regulated industry would have one believe that competition drives prices to relevant costs, and thus market-driven prices will force rates for local services to rise to the costs of providing the service; the rates for long distance services will be driven down to the level of cost by competing providers of interexchange services.

Federal regulators have found the industry's scenario acceptable.

State regulators, on the other hand, tend to believe that market-driven pricing is synonymous for pricing at a level that market forces will permit. Because inter-LATA services are currently subject to some competitive influences, rates have dropped. Similarly, because local exchange services exhibit increasing economies of scale, they should remain monopolistic, continue to be rigorously regulated, and be permitted to rise to costs, if they have not yet reached that level.

Currently, federal policy prevails: recovery of the significant costs of upgrading the switched network to accommodate competing interexchange services and newly enhanced local services are being reallocated from long distance usage charges to local subscriber access charges. These cost allocation exercises will continue as a manifestation of "market-driven" pricing.

Market-determined pricing is another reaction to real and perceived threats of competition: higher rates can be charged for those services which are less directly threatened with competition. Long distance voice and data services, enhanced local services, and customer-premised equipment no longer can contribute to the switched network. The appropriate proportion of common costs to be allocated to a particular service will continue to be a battleground for controversy.

Modernization. The fact remains that the major additional costs being incurred by America's exchange carriers are the costs of modernization. In Hawaii, at least 37 percent of recent rate increase requests were directly attributable to modernizing the network. Local exchange subscribers are bearing the brunt of the total costs of modernizing the switched network. Subscribers have been asked to finance the major write-down of antiquated customer-premised equipment; local exchange subscribers are paying the brunt of the costs of transforming the central office switching centers from analog to digital; soon, subscribers will be asked to pay the cost of modernizing the outside plant, extending optic fiber farther out into the distribution system, and shifting the switching facilities farther out into the distribution network. Regulators' assumption is that users are demanding the more sophisticated network.

Consumers' current concern is that upgrading the system to accommodate an integrated services digital network will become a discriminating process: to the extent the "cost-causers" of the rebuilt system can be identified, it is clear they are a small minority of the users. Yet the majority of the current users of the switched network will be paying for the modernized facilities years, if not decades, before they become users of such a network. This discrimination will be discussed, infra.

Highly-Differentiated Information. The characteristics of telecommunications users were briefly addressed according to traditional user groups in Section III. In order to understand future demands for the new services of high-tech telecommunications links, it is prudent to revisit the basic needs and wants associated with information and communication.

The use of telecommunications for informational exchange will likely migrate from the telephone to new services, including text, for two reasons: (1) most such calls are among businesses or institutions, rather than friends or family. Therefore, the cost savings and convenience realized by business afforded by use of a telecommunication link rather than an in-person contact will cause businesses and institutions to actively promote such use, and (2) the lack of affective cues available in voice is far less important to people when the goal is transactional (e.g. conveying a factual message, accomplishing a task, etc.). One caveat: the need for high technology to be balanced by "high touch" will influence, but not counter, such trends.

Text, particularly when coupled with graphic illustrative capability such as facsimile and videotex systems, can also handle more complex messages than verbal communication can provide. It therefore increases the capability of transmitting complex messages faster, and affords an opportunity to handle some messages via telecommunications links that were previously conducted in person.

Institutional structures which are evolving as we move into an information society, will provide further impetus for use of these new services. As our institutions change, so do our lifestyles. These lifestyles are key to our communication patterns. Institutions are rapidly moving toward more and more computerization. For example, while the federal level of government long ago moved to electronic processing its own information, new systems soon to be introduced will provide incentives for private individuals to electronically transact their business with government. The average person will need to conform and be more responsive in using telecommunications to search for, process, produce, and distribute information--first with government, and then with businesses.

Another factor--the relationship between people and places--is impacted by changing work patterns, changing leisure time preferences, the mobility of the population, and the dispersion of the population across geographic areas, both at the residential and business levels. Highly valued social links (Leichter and Mitchell in Rogers & Kincaid, 1981) as well as high quality informational links (Danowski, 1985) are maintained through telecommunication links when spatial distances are so great as to prevent in-person transactions--be they social or informational.

Understanding these three relational levels, as well as understanding the relationships among the traditional sectors of demand, are essential for prudent planning of telecommunications.

Considerations of geographic isolation are particularly important for Hawaii, as well as for other Pacific locales, where resources (human, informational, and material) to sustain commerce and a high quality of life must be imported from distant places.

Just as businesses become more information-dependent, consumers' need for information is growing. However, introducing more information into consumers' networks does not necessarily reduce uncertainty, as uncertainty increases with the expansion of alternatives. Even if information reduces uncertainty regarding a physical situation, it may increase uncertainty at the psychological level. Since social communication deals primarily with the psychological (informational relates more to the physical), the more information processing we do to function in daily life, the more important the telecommunications links become. Projecting situational conditions (for home use, the lifestyle; for business use, the marketplace) can assist in identifying the potential in increased dependence and breadth of telecommunications services that might come to be important in the future. Figure 1 is a simple matrix which assists in projecting communications demands stemming from any situation.

FIGURE 1

	Social Transactions	Informational Transactions
Expected (Predictable)		
Unexpected (Unpredictable)		
	Time 1 →	Time 2

If increasing needs for information regarding the physical and economic environment are accompanied by increasing needs to reduce psychological uncertainty, then industry's current projections of voice and video are far too conservative when juxtaposed against the projections of growth in data traffic.

Table 7 projects the growth of social and informational telecommunications links by number of calls and minutes of use based on two alternative assumptions--i.e. in Part A, informational transactions and social transactions are assumed to be independent of each other while Part B assumes they are related.

Table 7
Time Sensitive Demand Correlations
Part A. Assumes Informational Component Being Unrelated to the Social Component

	Set Ups (# of Calls/Day)			Duration (Minutes of Use)		
	1986	1990	1995	1986	1990	1995
Informational Interactions (40%)	2	3.0	4.4	5.0	7.5	11.0
Social Interactions (60%)	3	3.5	4.3	13.5	15.8	19.4
Total	5	6.5	8.7	18.5	23.3	30.4

Assumptions: Growth Rate - 10%/year = informational; 4%/year = social. Based on 1986 average of 5 cells/day; 4-1/2 minutes average duration for social call; 2-1/2 minutes average duration for informational call.

Part B. Assumes a Constant Proportion Between the Social Component and the Informational Component of Telephone Demand

	Set Ups (# of Calls/Day)			Duration (Minutes of Use)		
	1986	1990	1995	1986	1990	1995
Informational Interactions (40%)	2	3.0	4.4	5.0	7.5	11.0
Social Interactions (60%)	3	4.5	6.6	13.5	20.3	29.7
Total	5	7.5	11.0	18.5	27.8	40.7

Assumptions: Informational growth @ 10%/year. Social remains proportional at 60% of total social calls/day; 4-1/2 minutes average duration for social call; 2-1/2 minutes average duration for informational call.

A major conclusion in this regard is that for any responsible projection of future telecommunications demands and any socially-acceptable rational bases for pricing services to satisfy those demands, it is essential that the informational and social components of communication messages be combined and considered with the more traditional economic and engineering criteria.

Projecting demand by demographic and socioeconomic variables no longer suffices. There are intervening variables in demand: for example, as lifestyle changes, the relationships between demographics and telecommunications use change. Areas where several demographic variables interact are probably most important because they are a better assessment of lifestyle than any single characteristic.

Demand will grow exponentially in areas where two or more specific demographic characteristics having economic consequences converge. Relative to future residential usage, for example, projected growth in households by itself will reveal little that is meaningful about growth in usage; but any two factors, such as (1) growth in the population of working mothers and (2) future size of families, when combined for analytical purposes, will reveal highly relevant usage information. Long-term growth in usage drives growth in access. Hence, only by attempting to analyze multi-factor demographic projections, can we begin to account for information-age telecommunications needs.

Other space/time variables such as changes in the work structure, increasing information seeking, increasing educational levels, government computerization and many other factors indicate future telecommunications demands/needs will be far different than traditional demographic analysis is capable of projecting.

Communication message analysis can be of great assistance in any analysis of future communications demands, as well.

Approaching demand analysis from the cost perspective allows another dimension to be included in pricing concerns. Venturing beyond the obvious, it appears that after the network is digitized, the setup, receipt, flow and counterflow of bits will have short run incremental costs approaching zero. Assuming that regulation acts only in a surrogate capacity for competition, the costs users cause the new network should be predominantly access costs, with virtually no short run marginal costs. This scenario has monumental significance to the pricing of digitized bit flows--particularly when pricing ramifications of ISDN are considered. To predict the nature and quantity of future demands for usage where there will be virtually no usage costs and unknown but relatively equitable access costs among users presents a pricing dilemma that is indicative of the prevailing risks in today's telecommunications industry.

It is presently impossible to quantify with any precision how all these factors may interact to create new structures in an information-reliant economy. However, monitoring these changes as they occur, rather than relying on traditional demographic and income analysis, can help to minimize the disjunctures between future demand and future supply.

V. Users' Concerns with the Apparent Trends

Because the Hawaii market is comparatively small and geographically isolated, it has not been attractive to new entrant competitors. In the past, the benefits of competitive influences were delayed, if not denied, to Hawaii users because of a lack of competitors. Hawaii's users were long denied the benefits of advances in telecommunications technology (e.g. satellites' distance-insensitivity to costs). Even today there is well-founded fear by users that they will be deprived of the positive influences of pro-competition regulatory policies. Thus, prudent promotion of Hawaii's interests in telecommunications would not rely wholly on either regulation or competition.

Inter-LATA and International Services. Today, CONUS-Mainland rates are determined in part by competitive influences and, in part, by regulatory policies. If major interexchange carriers geographically de-average their rates as a response to competitive influences, Hawaii's long distance rates may tend to rise, regardless of costs, competition, or regulation. A major transpacific submarine fiber optic cable is being built between CONUS and Hawaii and between Hawaii and the Far East; costs will become more distance sensitive, and MTS/WATS/private line rates will be susceptible to becoming more distance sensitive. If the plans for a second transpacific fiber optic cable--one which is planned to by-pass Hawaii--becomes a reality, a substantially larger portion of the "revenue requirement" of the "via-Hawaii" cable could be allocated to both of the Hawaii segments of the cable. Hawaii's users of inter-LATA and international facilities have legitimate cause for concern because of both regulation (i.e. a return to the "return on a rate base" concept) and competition (i.e. expensive non-competitive fiber optic facilities).

Growth in Demand for Communications or Telecommunications? There is no demand for telecommunications facilities, *per se*, but rather, there exists demands for information and social conversation, with only indirect, or derived, demands for telecommunications facilities and services. The network is being rebuilt and reconfigured to transmit streams of bits/algorithms, in order to efficiently handle virtually unlimited flows of data over open networks.

Voice communications are, in a sense, less efficient than data flows. Yet, various studies have confirmed that the primary use of the telephone by residential customers is social communications, not informational. This major effort of networks toward accommodating video and data may have adverse impacts on future communications, generally. For example, there is mounting pressure to price exchange services on the basis of usage in order to optimize revenues, even though it may be shown to be detrimental to the basic demand to communicate. A review of the reasons for the mounting pressures is appropriate.

The telcos' customer base nationally, and in Hawaii, will grow at a rate in a range of 2 to 4 percent per year, and the growth in demand for access to the network will accelerate only slightly above that range of growth. Usage of network services, on the other hand, will grow at substantially accelerated rates, principally because of data traffic, store and forward services, and interactive services. Analyses of usage show two divergent trends--voice usage will show fewer attempts, and longer holding times; data transmission trends indicate rapid growth in number of attempts, with shorter holding times. A decade from now, the usage of the network is estimated to be at least three times as intense and highly diversified. Furtherance of the interests of the communicating public will depend, to a very great extent, on how these greatly diversifying and intensifying usages are priced.

The fundamental concern with the current trends is that a headstrong march for economic efficiency in accommodating the escalating growth of data transmission could be disruptive to the social bonds which will, in turn, reduce social well-being. If future services are priced in a manner which deters voice (social) communications, there can be an accelerating decline in social well-being. This process has been referred to as "social severance."

Access to the switched network includes both physical access as well as psychological access: physical access is the technological ability to access the system, while psychological access is a perception of the "freedom" to use the system. The potential loss of access may cause a disruption of social bonds, or relationships: (1) social communication, i.e. high on affective and integrational components, low on informational "objective fact" components; (2) primarily transactional and informational bonds; and (3) the time foreshortening characteristics of telecommunications, which maintain high value informational as well as social links between people and places. The potential for such disruptions need to be placed into the regulatory equation when making decisions about pricing and access to telecommunications services.

Discriminatory Services and Pricing. Another cause for concern is the growing potential for discriminatory practices in the provision and pricing of both regulated and unregulated telecommunications services. Except for the military and visitor industries, the commercial accounts in Hawaii's telecommunications market are relatively small. As we are witnessing in the airline and ground transport industries, large users of formerly regulated services receive preferential rates, and the average and smaller-than-average users are placed in a non-preferential, i.e. unfavorable, position vis-a-vis the large users. This has occurred with recent interexchange carrier tariff offerings, e.g. the most recent NYNEX proposal to taper access charges on the basis of usage.

Telcos' Financial and Market Positions Are Well-Fortified. Current policies permit regulated telecommunications providers to strengthen their financial situation under the umbrella of regulation while completely rebuilding their systems to be competitive for decades to come. This technological and financial transformation is supported by the regulated services. The modernization is occurring with internally generated funds (i.e. deferred taxes, retained earnings, and capital recovery). The new entrants who provide promise of competition are without the advantage of protective regulatory policies which allow telephone companies to vastly improve their productivity without requiring outside financing. If a more competitive environment does materialize in the future, the regulated local exchange carriers will then possess the ability to price very competitively: their new plant provides them declining incremental costs, and their conservative capitalization provides them the financial wherewithal to withstand any competitive challenge. Thus, whether basic or enhanced network-provided services ever become truly competitive should remain as a major political concern.

VI. Conclusion

To accurately discern trends from the current chaos is difficult; to correctly discern those trends, make a diagnosis, and issue a prescription in the form of a strategic plan to deal with perceived problems approaches the impossible. Yet the task of formulating meaningful public policy with future telecommunications users in the forefront of consideration must begin. Users' efforts must seek better pricing policies than have been proposed to date. Monitoring and evaluation must go forth to insure that every citizen--corporate or individual--has equal opportunity to access information as it will be served up via ISDN and other possible networks.

Regulators must re-commit themselves to a revised agenda: developing criteria to ensure that all users have the exercisable right of equal opportunity to access information; innovating the means to measure telecommunication providers' market power in order to protect and promote competition; and placing social criteria into the various regulatory formulae in order to fix prices, limit market shares, define adequacy of service, and declare what constitutes discrimination in order to further the interests of the public.

Only then will it be possible to bring public pressure to bear in order to protect and promote social communication. As our national economy becomes even more reliant on the currency of quality information, so also must regulators seek from the telecommunications and information service industries the quality information they need to make informed public decisions. In essence, the "relaxed regulation" that is becoming the law of the nation and states must not be construed to mean that regulators can relax. The tasks of regulating entities that are an indivisible amalgam of monopoly-like services and competitive services requires regulators who are more informed, more attentive, far more sophisticated, and more inclined to use their regulatory powers in a more selective fashion.

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SESSION 3
National Developments

Results of Selected Experiences with Local Charging Systems and Network Digitalization in Chile.

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Summary

This paper deals with past experiences in Chile on digital telecommunications technology; with outcomes of the charging system; Chile's networks; the application of a cost charging system; and, with developed studies on the feasibility of new voice and data services. The presentation focuses on two digital technological advances: (a) Urban and long distance cost charging system, and (b) Digitalization of urban telephone networks.

With the urban and long distance cost charging system, Chile Telephone Company (CTC) has improved its image and the quality of its urban telephone service. This has been done by applying fare costs during peak traffic hours. This allows subscribers to have more control over cost charges per call. It also produces a redistribution of calling patterns during the day. The implementation of this long distance cost charging system has permitted the introduction of the long distance direct dialing service, utilizing the existent infrastructure, dramacally accelerating communications between cities throughout the country.

Digitalization of CTC networks has resulted in the evolution of two separated networks, one at a digital level and the other at analog. It also resulted in the construction of urban digital trunks, which also facilitated interconnection between both networks and levels. The approach promotes long-range planning of digital networks, both urban and interurban, providing all technical and operative advantages of the new technology. Telephone network digitalization makes possible the introduction of supplementary services for the subscribers to the switching network and assists in planning for the implementation of data communication services.

The basic telephone services to subscribers include: automatic connections (local and long distance); operator-assisted connections and information; prerecorded messages; community emergency services; and other services. Presently the complementary services offered, by means of a combined analog-digital network are: low speed data communications (up to 2400 bps); facsimile; telex; mobile radio-telephone; teletext and videotext; and so forth. The digital network will be able to handle an extended range of new services to users, provide data transmission over switched networks at 64 Kbps, and provide the context of the future development of an Intergrated Services Digital Network (ISDN).

EXPERIENCIAS EN CHILE SOBRE SERVICIO LOCAL MEDIDO Y DIGITALIZACION DE REDES Y RESULTADOS SOBRE SUS SERVICIOS

(A NOTEWORTHY EXPERIENCES IN CHILE WITH LOCAL CHARGING SYSTEM AND NETWORKS DIGITALIZATION AND THE RESULTS ON ITS SERVICES)

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1. Resumen

En el presente trabajo se dan a conocer las experiencias logradas en Chile en tecnología digital de telecomunicaciones, los resultados obtenidos en la digitalización de sus redes y en la aplicación del sistema medido de tasación, y los estudios desarrollados sobre la factibilidad de nuevos servicios tanto vocales como no vocales.

2. INTRODUCCION.

Se pretende con este trabajo dar a conocer las experiencias adquiridas por la Compañía de Teléfonos de Chile (en adelante CTC) en tecnología digital desde su introducción en Chile y los resultados logrados, tanto en potencialidad y calidad de sus redes de telecomunicaciones, como en la aplicabilidad de nuevos servicios vocales y no vocales. Lo anterior, por haber CTC implementado oportunamente en sus redes telefónicas las innovaciones y los adelantos tecnológicos digitales, centrándose esta presentación en dos de ellos, los más relevantes por su incidencia en la introducción de nuevos servicios de telecomunicaciones que son:

a) Sistema Medido de Tasación Urbana y de Larga Distancia, y
b) Digitalización de las redes telefónicas urbanas.

3. SITUACION ACTUAL Y FUTURA DE CTC

La situación de la red CTC al año 1985 está caracterizada por la existencia del orden de 553.000 líneas instaladas, de las cuales 96% son automáticas con un grado de digitalización de 35%. A nivel del país, CTC tiene una cobertura de 77% del territorio continental, con 96% de teléfonos instalados atendiendo al 92% de la población nacional. De las trece regiones en que se divide el país, dos de ellas son atendidas por otras empresas. Las restantes son servidas por CTC, existiendo eso sí en la Región Metropolitana (Santiago) y en la V Región (Valparaíso), localidades urbanas dentro de las cuales hay sectores geográficos superpuestos para otorgamiento de servicio telefónico urbano en que CTC tiene, respectivamente del orden de 110.000 y 22.000 líneas en servicio, las que se superponen, con 6.500 y 2.400 líneas de otras empresas telefónicas. El grado de participación CTC en estos sectores es del orden de 94% y 90%, respectivamente.

Iniciamos la presentación con una breve descripción de los Planes de Desarrollo de CTC, en base a tecnología digital para el período comprendido entre los años 1980 y 1995, dando especial énfasis al Proyecto de Ampliación de Líneas Período 1980-1985 recientemente terminado, y que significó instalar un total de 253.500 líneas, de las cuales el 75% fueron digitales.

Al año 1980 la red de telecomunicaciones de CTC estaba basada en la tecnología analógica y constituida, en general, por equipos de conmutación electromecánica con enlaces de transmisión analógica, alcanzando una densidad de 5,4 teléfonos por 100 habitantes y un grado de automatización de 92%.

A partir de 1983, con la adquisición de las primeras centrales digitales, CTC inició un ambicioso programa de expansión de su red mediante el desarrollo de diversos proyectos de ampliación de líneas telefónicas, considerando además, la posibilidad de ofrecer en un futuro próximo una variada gama de nuevos servicios. Es así como terminada la instalación del proyecto de ampliación de líneas digitales, período 1983-1985, fue posible poner en servicio un total de 191.000 líneas de tecnología digital.

Con el fin de dar continuidad al desarrollo telefónico, se ha elaborado un Plan Decenal cuyo objetivo se extiende a toda el área atendida por CTC y su cumplimiento permitirá tener instalado a fines del decenio, es decir, en el año 1995 un total aproximado a 1.180.000 líneas.

En la Figura 1 puede verse los diferentes indicadores de desarrollo de las telecomunicaciones en el área servida por CTC para los años 1980 al 1995, a través de los cuales puede percatarse como al año 1995, si se logra realizar las inversiones propuestas, será posible alcanzar a satisfacer plenamente la demanda esperada a esa fecha, considerando que al año 1985 el déficit de líneas era de 26%. Pese a esto al año 1995 la densidad telefónica estimada será sólo del orden de 9 líneas telefónicas por 100 habitantes con una penetración telefónica correspondiente a un tercio de las viviendas. Este plan también contempla atender localidades rurales que requieran servicios telefónicos mediante instalaciones de pequeñas centrales o, en su defecto, mediante teléfonos públicos de larga distancia. Este Plan Decenal no considera satisfacer la demanda rural dispersa, en razón de sus altos costos de inversión y su muy baja rentabilidad.

La primera etapa de este Plan Decenal denominado Plan de Desarrollo a Corto Plazo abarca el período 1986-1989 y corresponde a la instalación de aproximadamente 223.000 líneas telefónicas, Plan que se encuentran aprobado; parte en proceso de instalación y parte en proceso de licitación.

El objetivo de los planes de desarrollo CTC es lograr triplicar al año 1995 la cantidad de líneas instaladas al año 1980. Esto significa en términos globales instalar anualmente un promedio de aproximadamente 52.000 líneas telefónicas, para lograr al año 1995 superar el millón de líneas con un 69% de digitalización.

4. SISTEMA MEDIDO DE TARIFICACION URBANA Y DE LARGA DISTANCIA.

Veremos como el desarrollo de avanzadas técnicas digitales controladas por microprocesadores y de VLSI, ha permitido a la CTC incorporar en el año 1980 en sus centrales analógicas, un sistema de tasación con gran flexibilidad de estructura en el otorgamiento de servicio local medido (SLM) y tasación detallada globalizada de las llamadas de larga distancia nacional e internacional.

Su necesidad, principalmente debido al crecimiento excesivo de la cantidad de llamadas locales por línea telefónica, del orden de 14%. Esto hizo necesario para mantener la calidad de servicio poner en reserva técnica, aproximadamente 12% de las líneas instaladas en las grandes ciudades, principalmente en Santiago.

En el año 1978, CTC adjudicó a la firma ALSTON mediante una licitación internacional la instalación en sus centrales de un sistema de tarificación, con una estructura tarifaria muy flexible, que permitió a la Compañía implementar, en el año 1980, el discado automático interurbano y al año siguiente la tasación de las llamadas urbanas.

La estructura de tasación del sistema conocido como "servicio local medido" permitió, por su flexibilidad, aplicar diferentes valores de cobro, por establecimiento de la comunicación y por su duración real, para diferentes horas del día, empleando valores más altos en las horas de tráfico de punta y reducidas para el horario de bajo nivel de uso, por ejemplo, de noche. Este sistema es más preciso que el utilizado tradicionalmente de multimetraje, porque permite tasar según la duración real de cada comunicación.

El SLM determina el valor del cargo de cada comunicación mediante la expresión $CE + D*CD/60$, donde CE es el cargo por establecimiento, D es la duración de la comunicación en segundos y CD es el cargo por un minuto de duración. Su resultado es almacenado y totalizado en un registro dedicado por cada número telefónico.

Cuando se introdujo el SLM en abril de 1981, la estructura constaba de dos tramos horarios, de 09 a 19 horas tarifas altas (A) y corresponde a las horas de alto tráfico, y de 19 a 09 horas tarifas nocturnas (D). El cargo por establecimiento de cada llamada de tarifa A era el doble del de la tarifa D. En cuanto al cargo por duración de cada llamada, el de la tarifa A era cinco veces el de la tarifa D. A octubre 1985 estas razones aumentaron a tres veces y 28,6 veces, respectivamente. En la Figura 2 puede apreciarse cómo evolucionó la distribución de los tramos horarios de SLM.

Desde 1981 a 1986, la estructura tarifaria ha sido modificada, cambiando seis veces su forma de agrupación horaria y 10 veces sus precios. De diciembre 1982 a junio 1984 se aplicó una estructura con tres tramos horarios, en septiembre 1984 se volvió a una similar a la del inicio, es decir, con dos tramos horarios, pasando nuevamente en diciembre 1984 al de tres tramos y en octubre 1985, al actual, con cuatro tramos horarios. Las tasas de relaciones entre los cargos que parecen ser arbitrarios, fueron los resultados de los diversos cambios ocurridos en estos cinco años y basados en estudios de rentabilidad y aprobaciones de autoridades económicas y normativas.

En la Figura 3 aparece el precio por llamada local de 3 minutos de duración realizada dentro de cada tramo horario desde la fecha de implementación del SLM hasta el último reajuste de julio de 1986 y en la Figura 4, la evolución de las razones de los precios por llamada urbana correspondiente a los diferentes tramos horarios también para llamadas de 3 minutos de duración. En esta figura se puede apreciar en sus columnas cómo las razones entre las tarifas alta y nocturna aumentan desde 4,25 a 21,64, es decir, del orden de 5 veces. En igual forma, entre las tarifas media y nocturna, de 4 a 14,6, es decir, 3,6 veces, y los valores de las razones entre tarifas alta y media, fluctuando ligeramente entre 1,19 y 1,82.

La introducción del SLM con su estructura horaria generó muchas polémicas y requirió de arduas labores de convencimiento técnico y económico, tanto a los organismos normativos y económicos del Estado, como también a los usuarios potenciales. Para este efecto, CTC debió apoyarse en lo económico en diversos estudios tarifarios propios y otros por institutos asesores, privados y universitarios. La fundamentación técnica estuvo dada por la necesidad de lograr obtener un cambio en el comportamiento del usuario del servicio telefónico y así paliar en gran medida la situación de excesivo tráfico en las horas de mayor actividad comercial.

Efectivamente, el SLM a través de la distribución horaria escalonada de precios con un alto cobro en las horas de tráfico de punta, permitió reducir el tráfico promedio cursado en las centrales en las horas activas, y poner en servicio del orden de 15.000 líneas que estaban en condiciones de reserva técnica. Sin embargo, en la red urbana de Santiago sigue aún siendo alto el valor de tráfico promedio por línea (0,12 erlangs) comparado con el tráfico promedio de diseño de fabricación de la central y con similar indicador obtenido en los países desarrollados, con valores superiores en las centrales ubicadas en sectores comerciales. Todo lo anterior, permite concluir que es fundamental mantener una diferencia de tarifa suficientemente alta entre la de las horas de llamadas de punta y la de otras de menor demanda, recomendación mientras persista la situación de densidad de líneas en servicio por 100 habitantes inferior a la requerida realmente para dar satisfacción a las necesidades de comunicaciones telefónicas. Esto permitirá, a la larga, mantener o reducir el costo de inversión por línea que a su vez se reflejará en el precio del servicio, lo cual beneficiará a los usuarios telefónicos.

También este sistema de tasación permitió introducir en el año 1980 el servicio de discado directo interurbano con tarificación detallada de cada llamada entre las ciudades de Santiago, Valparaíso y Concepción, y al año 1983 entre la mayoría de las ciudades del país. En el año 1983 se comenzó con el servicio de discado automático internacional, otorgando este servicio a los suscriptores de Santiago y al año 1985 a la mayoría de las ciudades importantes del país. Por otra parte, la implementación de centros de conmutación digital permitió, además de los servicios de tarificaciones SLM y detallado de las llamadas de larga distancia nacional e internacional, introducir en estas centrales el servicio de teletasación para operar teléfonos recaudadores automáticos y el servicio de información inmediata de tarifa a hoteles y a concesionarios de teléfonos públicos.

5. DIGITALIZACION DE LAS REDES CTC.

A continuación veremos como fue el comienzo de la digitalización en Chile. La CTC instaló entre los años 1983 y 1985, equipos digitales de conmutación y de transmisión, lo que ha significado que a diciembre de 1985 estén en servicio casi doscientas mil líneas digitales.

En septiembre de 1979 se recibieron ofertas por equipos de conmutación para ampliaciones de líneas en las ciudades de Santiago, Valparaíso y Concepción, presentadas por 11 proveedores, conformando un total de 23 soluciones para los proyectos incluidos en la licitación, de los cuales 12 estaban basados en la utilización de tecnología digital.

La evaluación técnica se realizó de acuerdo a un método elaborado por CTC y en cuya etapa final de revisión se contó con la asesoría de Continental Telephone International. Dicho método evalúa el grado en que cada sistema ofrecido se acerca a las condiciones ideales definidas para un equipo de conmutación en las áreas de software, hardware y facilidades de administración.

En cuanto a los criterios de evaluación para la adecuada comparación de las ofertas, ellos consideraron en general todos los costos involucrados en la introducción de un determinado equipo en la red existente, tales como, costos de instalación y puesta en marcha del equipo, los costos de interconexión con el resto de las centrales en servicio y costos de operación y mantenimiento.

El resultado técnico-económico recomendó la solución digital, adjudicando la licitación a la empresa THOMSON-CSF en el año 1980, instalándose finalmente 186.000 líneas digitales en 25 centros de conmutación entre los años 1983 y 1985, en las áreas multioficinas de Santiago, Valparaíso y Concepción, de los cuales 77% fueron en Santiago.

Daremos a continuación una breve descripción de la digitalización de la red automática metropolitana de Santiago, por su complejidad e importancia.

En 1980 la red totalmente analógica constaba de 32 centrales, entre las cuales 13 realizaban la función de tránsito para las centrales terminales que la requerían.

Diversos estudios de planificación de la red a mediano y a largo plazo, tomando un período de ampliación de 20 años, demostraron que era conveniente la pronta introducción de tándems urbanos en el área de Santiago, ubicados uno en cada sector constituido por un conjunto de centrales, y conformando, estos tándems urbanos, una malla de jerarquía superior con respecto al resto de las centrales locales.

A través del análisis dinámico a largo plazo, se demostró que la solución óptima era considerar tres tándems urbanos digitales y la conveniencia de su introducción, en los programas inmediatos de expansión de líneas. Esta solución óptima queda justificada principalmente por dos razones: a) Alto costo de conmutación por erlang marginal en los equipos de barras cruzadas, comparado con el del equipo de tecnología digital; y b) En la mayoría de las centrales electromecánicas no existía espacio para instalar equipos necesarios para incorporarles la función de tránsito, agravado por el hecho que éstas requieren espacios que son 2 a 3 veces mayores que los necesarios en tecnología más moderna.

Lo anterior avalado por los excelentes precios y la tendencia mundial de fabricación de equipos de telecomunicaciones de tecnología digital, que además posee mayores facilidades de administración y de nuevos servicios, permitió a la Compañía decidirse a efectuar las nuevas instalaciones de líneas mediante centrales digitales, realizando la mínima inversión en tecnología electromecánica.

Como consecuencia de lo anterior, a fines de 1985 la red automática de Santiago, quedó conformada por unas 320.000 líneas instaladas en 43 centrales, de las cuales 27 son analógicas y 16 de tecnología digital. La implementación oportuna de la digitalización masiva ha permitido por una parte estructurar dos redes separadas una conformando un plano digital y la otra el analógico, y por otra parte la creación de los tándems urbanos digitales que además facilitan la interconexión entre ambas redes o planos. Estos tándems digitales también hacen la función local, de modo que son centros combinados local/tándem. Su posibilidad de selección de rutas alternativas ha permitido a CTC optimizar tanto la red digital como el conjunto de redes digital-analógica (Ver Figura 50). Esta concepción separada de redes permite una planificación ordenada de las redes digitales, tanto urbanas como interurbanas, otorgando todas las ventajas técnicas y operativas de la nueva tecnología y lo beneficios que reprsenta la limpia evolución de su estructura de red digital y lograr así a futuro el desarrollo de Redes Digitales de Servicios Integrados (RDSI).

La red digital urbana implementada al año 1985, realiza la interconexión entre las centrales digitales mediante enlaces con sistemas MIC (30 + 2), con característica bidireccional de tráfico y señalización MFC R2, instalándose del orden de 1.000 sistemas MIC. La interconexión de las nuevas centrales con las centrales analógicas también se efectúa con enlaces MIC, con los conversores ubicados en el extremo analógico.

Además esta red digital de Santiago fue proyectada y ejecutada considerando la sincronización de los intervalos de tiempo de la señal digital, por su importancia para la futura introducción de servicios de datos a 64 Kbps. La instalación consta de un sistema de sincronización maestro-esclavo de los relojes de las centrales, con estructura jerarquizada de éstas para dar la máxima fiabilidad. El reloj maestro atómico tiene una gran confiabilidad y una estabilidad de frecuencia a largo plazo de 1×10^{-11}. La proporción de deslizamiento en cualquier canal a 64 Kbps de cualquier central, no es superior a uno en cada 70 días, en condiciones de funcionamiento normal.

En cuanto al plan de señalización entre las centrales digitales, éste es mediante la señalización MFC R2, con 6 tonos hacia adelante y 6 hacia atrás, empleando la designación de las señales según lo recomendado por la CCITT asignando parte de las señales de reserva para uso nacional para la necesidad operativa de la red. Además en estas centrales digitales está contemplado la futura implementación de la señalización N° 7 por canal común, requisito básico para la futura introducción de RDSI.

En resumen la concepción de la estructura de redes separadas en planos digital y analógico, en las grandes áreas metropolitanas, contemplada en los estudios de planificación de las redes CTC, permitirá una ordenada evolución de las redes digitales a 64 Kbps hacia la red digital de servicios integrados (RDSI).

6. INTRODUCCION DE NUEVOS SERVICIOS.

Para la introducción de nuevos servicios es necesario previamente cuantificar el requerimiento de los usuarios, según los servicios. Significa precisar las necesidades de la demanda a través de estudios de mercado por tipo de servicio. Su predicción es compleja e incierta por desconocer el real comportamiento de los usuarios ante los nuevos servicios, y envuelve riesgos financieros al realizar inversiones, al no conocer la real demanda. Por otra parte, la diversificación de los servicios puede provocar un aumento en el número de redes de transporte y de interfaces con los usuarios. Un modo de limitar la dispersión de inversiones y reducir los riesgos es utilizar, hasta donde sea posible, un sistema de transporte único, siendo ésta la solución ideal. En el largo plazo, la RDSI podrá ser esta solución y dar respuesta a la red de transporte común para converger las señales de los diferentes servicios, originados en sus terminales y accesado vía interfaz de conexión de uso múltiple para los diversos servicios.

Por lo tanto, ponderando adecuadamente aspectos, tales como, los limitados recursos de inversión del Sector Telecomunicaciones; el desarrollo y amplio grado de cobertura de la red telefónica en cada área urbana y a lo largo de todo el país; la digitalización de la red telefónica ya iniciada durante el año 1983; la calidad de servicio de la red telefónica actual, que la hace apta para la transmisión de datos y otros servicios telemáticos hasta velocidades de 2.400 bps; hace concluir que la red telefónica aparece naturalmente como el medio más adecuado para el transporte de los nuevos servicios de telecomunicaciones, durante el período de transición hacia la Red Digital de Servicios Integrados (RDSI), como lo define la reciente Recomendación G.705 (1982). Dice al respecto, la RDSI es una red desarrollada a partir de la red digital integrada telefónica, que provee conexiones digitales extremo a extremo y que soporta una amplia variedad de servicios, incluyendo servicios vocales y no vocales, y a la cual tienen acceso los usuarios mediante un número limitado de interfaces normalizadas.

Las ventajas de utilizar la infraestructura existentes son claras:

- El valor de la inversiones realizadas se conserva.
- Las nuevas inversiones serán relativamente moderadas y podrán ofrecerse los servicios a un número masivo de usuarios, permitiendo alcanzar rápidamente un nivel adecuado de rentabilidad.

En países en desarrollo, con recursos limitados, es conveniente poner especial atención en la utilización más eficiente y productiva de sus recursos de telecomunicaciones. Existiendo diversas soluciones para satisfacer las demandas de los nuevos servicios, la alternativa más adecuada deberá estar basada en medios que permitan satisfacer, tanto como sea posible, el máximo de necesidades de servicios mediante una solución integral. En este contexto, la futura red digital de servicios integrados, que evolucionará a partir de las redes digitales, parece ser la mejor solución.

6.1 CLASIFICACION DE LOS SERVICIOS.

Es posible clasificar los servicios de acuerdo a las características generales de las redes públicas de telecomunicaciones actuales, considerando las potencialidades de las nuevas tecnologías, de la siguiente manera:

a) Servicios Fundamentales o Básicos.

Son aquellos servicios que se suministran a los usuarios, a través de una red conmutada, con comunicaciones bidireccionales dedicada básicamente a un servicio específico, las cuales deben interconectarse con redes existentes del mismo tipo de servicio, por ejemplo, telefonía, telegrafía o télex, transmisión de datos, etc.

b) Servicios Telefónicos Suplementarios.

Son aquellos servicios que se puede ofrecer a los usuarios utilizando principalmente las potencialidades inherentes de las redes telefónicas, y se dan en conjunto con el servicio telefónico. Son por ejemplo, servicios de abonado ausente, de transferencia de llamadas, de marcación abreviada, servicio despertador, servicio de indicación de llamada en espera, multiconferencia.

c) Servicios Complementarios.

Son aquellos servicios públicos de telecomunicaciones uni o bidireccionales que se suministran a los usuarios, a través de la red de un servicio fundamental o básico, utilizando equipos terminales apropiados que permiten el interfaz entre el servicio fundamental y aquel servicio complementario que se desea introducir. Los servicios complementarios, por ejemplo, buscapersona, facsímil, televigilancia, transmisión de datos por la red telefónica conmutada, teletex, videotex, etc.

6.2 CARACTERISTICAS TECNICAS DE LAS REDES PARA OTORGAMIENTO DE NUEVOS SERVICIOS.

Desde el punto de vista técnico, estos servicios pueden realizarse mediante:

- Las facilidades que cuentan las centrales.
- El uso de la red automática.

Entre los primeros están los servicios telefónicos básicos y suplementarios.

Los servicios telefónicos básicos actualmente posible de ofrecer a todos los abonados comprenden: las comunicaciones telefónicas automáticas (local y larga distancia), el acceso a las operadoras para el establecimiento de las comunicaciones y ayuda (información, atención de reclamos, etc.), acceso a anuncios grabados y a los servicios de emergencia de la comunidad y otros.

Los servicios complementarios que se puede ofrecer actualmente a través de la red telefónica conjunta analógica digital son: comunicaciones de datos de baja velocidad (hasta 2.400 bps), facsímil, télex, radio telefonía móvil, buscapersona, teletex, videotex y otros.

Por otra parte, solamente a través de la red digital, como lo es actualmente en Santiago, Valparaíso y Concepción, CTC pretende ofrecer a los usuarios una amplia gama de servicios suplementarios, tales como: discado abreviado, transferencia automática de llamadas, conferencia, espera sobre línea ocupada, cobro revertido automático, servicios libres de tasación, información de abonado ausente, justificación inmediata de tasa y otros.

Esta red telefónica podrá eventualmente ofrecer una amplia gama de nuevos servicios a los usuarios, a través de redes conmutadas de datos de transmisión de 64 Kbps y otorgar servicios de comunicaciones de datos a alta velocidad como facsímil, teletex, y otros servicios complementarios mencionados más arriba, pero todos de mayor velocidad de transferencia.

La Compañía ha iniciado estudios en la implementación de transmisión de datos a 64 Kbps entre usuarios mediante la red urbana digital. Para ello tiene contemplado realizar en el bucle de abonados pruebas de transmisión de señales de 64 Kbps y estudios de factibilidad técnica para su interfaz con los centros de conmutación digital a intervalos de tiempos correspondientes a un canal MIC.

A continuación, veremos los estudios desarrollados para la introducción en las redes CTC de nuevos servicios suplementarios y complementarios de telecomunicaciones para satisfacer las necesidades de los usuarios.

6.3 SERVICIOS SUPLEMENTARIOS Y COMPLEMENTARIOS.

En general, la estimación y proyección de demanda de nuevos servicios suplementarios y complementarios, requiere de alguna manera, previo a cualquier encuesta de mercado, dar a conocer estos nuevos productos a los suscriptores potenciales y relacionarlos con ciertas tarifas para cuantificar el volumen del mercado potencial.

a) Servicios Suplementarios.

La Compañía ha terminado de realizar un estudio de demanda en las áreas multioficinas de Santiago, Valparaíso y Concepción de 9 servicios suplementarios, de un total del orden de 60 existentes, que son: Indicación de llamadas en espera, Marcación abreviada, Teletasación de abonados, Comunicación en conferencia, Despertador, Abonado ausente, No molestar, Retención para consulta a otro número telefónico, Repetición del último número marcado.

La investigación del mercado se basó en dos muestreos separados, uno residencial y uno comercial, para cada ciudad.

Se utilizó un tamaño muestral de 480 encuestas, considerando un error admisible de 5%, un intervalo de confianza de 95% y una sobre estimación del tamaño muestral por posibles rechazos de 25%.

En estas tres ciudades se realizó del orden de 3.000 encuestas y previo al desarrollo de éstas, se enviaron folletos explicativos de los servicios a los suscriptores CTC seleccionados. En la Figura 6 se ven los resultados obtenidos para los residenciales y comerciales por priorizaciones de demanda por los potenciales usuarios en Santiago. Los resultados obtenidos en otras ciudades fueron similares a los de Santiago, para los cinco primeros servicios, salvo algunos cambios en la ubicación entre ellos. Como puede apreciarse los intereses de los potenciales usuarios residenciales encuestados a través de los estudios de mercado, han seleccionado como de mayor interés, servicios suplementarios similares a los que podría haberse estimado utilizando los valores de las tarifas mensuales informadas en las encuestas y los beneficios directos que estos servicios significan para sus quehaceres sociales, siendo éstos: Indicación de llamada en espera, Despertador, Repetición del último número marcado y No molestar. En cuanto a los potenciales usuarios comerciales, sus intereses son otros, salvo el primero similar a los residenciales. Los otros tres según demanda son: Marcación abreviada, Repetición del último número marcado y retención para consulta a otros números telefónicos.

En la Figura 7 se puede apreciar las demandas estimadas iniciales por 100 líneas en servicio, para cada tipo de servicios suplementarios, y la tasa anual de crecimiento correspondiente, obtenida de las encuestas y aplicando los resultados obtenidos en otros países en que se han ofrecido estos servicios.

b) Servicios Complementarios.

Respecto a los servicios complementarios, CTC ha completado el estudio de mercado, también a través de un procedimiento de muestreo similar al de los servicios suplementarios, para los siguientes servicios: Facsímil, Teletex y Comunicaciones de datos.

El estudio se efectuó principalmente en usuarios comerciales por la naturaleza del servicio encuestado, ya sea por el tipo de información que se envía o por la rapidez de envío que precisan hacer de un punto a otro del país.

Para los estudios de facsímil y teletex se supuso un cargo de instalación del orden de US$ 500.- y un cargo mensual de alrededor de US$ 50.- El resultado del estudio permitió determinar la demanda de cada servicio obteniendo para el año 1986 aproximadamente 900 conexiones con equipos terminales incluidos, considerando las tres ciudades encuestadas y un crecimiento estimado de 12 a 16% anual para los servicios telefax y teletex, respectivamente. En cuanto al número promedio de páginas diarias por terminal se estimó que era para usuarios de Santiago y para comunicaciones hacia afuera de la ciudad del orden de 8 y 5 páginas diarias respectivamente para los servicios telefax y teletex. Mientras para las comunicaciones urbanas resultaron del orden de 6 y 5 páginas diarias respectivamente, siendo mayor el tráfico para telefax para estas comunicaciones dentro de la ciudad. Se estimó que el tráfico promedio total originado hacia los usuarios terminales tanto urbanos, interurbanos como internacionales era del orden de 25.000 páginas diarias.

En cuanto al servicio de comunicaciones de datos a través de la red conmutada se consideró para el estudio de mercado un cargo de instalación de US$ 250.- y un cargo mensual de suministro de US$ 25.- De las 527 entrevistas efectuadas a firmas comerciales, el 95% poseen a lo menos un procesador de datos y el 60% están interesados en implementar un sistema de comunicaciones de datos, y la demanda estimada de este servicio para el año 1986 cuantificada por el total de enlaces de la red conmutada telefónica es del orden de 8.000 conexiones con equipos modems incluidos, y del orden de 5.000 conexiones sin modems, totalizando alrededor de 13.000 conexiones, con una tasa de crecimiento anual de 10%.

Los resultados obtenidos de la evaluación económica preliminar considerando que se otorgan servicios de comunicaciones de datos en las ciudades de Santiago, Valparaíso y Concepción, dieron excelentes resultados utilizando los antecedentes de llamadas de los estudios de mercado desarrollados por CTC al respecto, tanto para el caso en que CTC ofrece en arriendo los equipos modems como para el caso en que estos equipos modems son pagados por terceros. Se obtuvieron valores actualizados netos del orden de US$ 8.000.000.- para ambos casos y una tasa interna de retorno superior al 30% para el primer caso y del orden de 100% para el segundo.

7. CONCLUSIONES

En cuanto a los servicios de telecomunicaciones, CTC a través de la modernización de sus redes urbanas y la aplicación de las tecnologías digitales, pudo obtener los resultados previstos e ir cumpliendo con sus planificaciones a corto y mediano palzo en el desarrollo de sus redes y en la introducción de nuevos servicios.

a) Servicio Medido de Tasación.

Mediante SLM y Tasación de larga distancia CTC logró mejorar su imagen y la calidad de atención del servicio telefónico urbano a los usuarios por el cobro justo según la utilización real del servicio telefónico y por haber aplicado a las horas de tráfico de punta, una tarifa alta que permitió a los usuarios alternativas de precio por llamada que produjo una redistribución de las llamadas en los diferentes tramos horarios aliviando la congestión de la red.

Respecto a la implementación de tasación detallada de larga distancia, CTC logró a través de los mismos equipos del sistema SLM, por su factibilidad de tasar en forma detallada las llamadas cursadas según el prefijo de numeración discado, introducir el servicio discado directo distante (DDD) aprovechando al máximo las estructura existente, agilizando notablemente las comunicaciones interurbanas a lo largo del país que se hacía hasta entonces en forma manual vía operadora. Posteriormente, también se pudo ofrecer dicho servicio para las comunicaciones internacionales.

b) Digitalización de las Redes Urbanas.

La digitalización masiva en el área multioficina de Santiago con centros digitales, en forma simultánea, oportuna y de amplia cobertura, dio la posibilidad de constituir una red urbana digital (plano digital con 3 tándems), separada de la red analógica existente (plano analógico con 7 tándems), ambas redes interconectadas a través de los tándems digitales mediante enlaces MIC y optimizada a través del uso de rutas alternativas. En resumen, esta flexibilidad de la tecnología digital hará posible introducir los servicios suplementarios a los usuarios de la red conmutada y planificar la implementación de servicios de comunicaciones de datos a 64 Kbps y otros servicios telemáticos de alta velocidad. Estos servicios, salvo algunos suplementarios, no podrán ser accesados por usuarios de líneas de la red analógica.

La Compañía está estudiando la factibilidad de introducir a corto plazo la implementación de la transmisión a 64 Kbps a través de la red digital conmutada telefónica y teniendo como meta lograr dar una variedad de servicios a los usuarios a través de su evolución hacia la RDSI.

La red conjunta analógica-digital permite sin mayores inversiones, cuidando de no utilizar líneas de centrales paso a paso por su alto nivel de ruidos impulsivos, ofrecer los servicios complementarios a baja velocidad hasta 2.400 bps.

Esto a la larga significará que en el área multioficina habrán dos tipos de líneas, una digital con posibilidad de ofrecer servicio de todo tipo y la analógica con servicios restringidos.

c) Nuevos Servicios.

Los estudios de mercado de servicios suplementarios y complementarios y su preevaluación económica demuestran las ventajas de ofrecer a la brevedad estos servicios a los suscriptores CTC. Su introducción dependerá principalmente de la adecuación de los softwares en las centrales digitales existentes. Respecto a los servicios teletex, telefax y comunicaciones de datos a través de la red conmutada telefónica, también los resultados preliminares de evaluación económica hacen atrayente su comercialización por CTC.

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FIGURA 1

INDICADORES DE DESARROLLO, PERIODO 1985-1995

	1980	1985	1989	1995
LINEAS EN PLANTA	396.000	553.000	737.500	1.178.000
LINEAS DISPONIBLES PARA SERVICIO	360.000	535.000	-	-
GRADO DE AUTOMATIZACION	92%	96%	99,7%	99,9%
GRADO DE DIGITALIZACION	0%	35%	47%	69%
DENSIDAD DE LINEAS POR 100 HABITANTES	3,5	4,8	6	9
PENETRACION TELEFONICA, LINEAS POR 100 VIVIENDAS	16	21	26	36
PROYECCION DE DEMANDA DE LINEAS TELEFONICAS	510.000	685.000	859.000	1.136.000
DEFICIT DE LINEAS	42%	30%	20%	0%

FIGURA 2

EVOLUCION DE LA DISTRIBUCION DE TRAMOS HORARIOS DE SLM

FECHA DE CAMBIO TARIFA	NUMERO DE TRAMOS HORARIOS	A ALTA	B MEDIA	C BAJA	D NOCTURNA
ABRIL 1981	DOS	09 a 19	-	-	19 a 09
DICIEMBRE 1982	TRES	10 a 13 15 a 18	08 a 10 13 a 15 18 a 21	-	22 a 09
OCTUBRE 1983	TRES	10 a 13 15 a 19	09 a 10 13 a 15 19 a 22	- -	22 a 09
FEBRERO 1984 (SIMILAR OCTUBRE 1983)					
JUNIO 1984 (SIMILAR OCTUBRE 1983)					
SEPTIEMBRE 1984	DOS	09 a 19	-	-	19 a 09
DICIEMBRE 1984	TRES	10 a 12 16 a 17	09 a 10 12 a 16 17 a 20	-	20 a 09
JUNIO 1985 (SIMILAR DICIEMBRE 1984)					
OCTUBRE 1985	CUATRO	10 a 12 16 a 17	09 a 10 12 a 13 15 a 16 17 a 18	13 a 15 18 a 20	20 a 09

FIGURA 3

PRECIO POR LLAMADA LOCAL DE 3 MINUTOS DE DURACION

FECHAS	A	B	C	D
ABRIL 1981	2.04	-	-	0.48
DICIEMBRE 1982	3.84	2.40	-	0.60
OCTUBRE 1983	5.39	2.96	-	0.71
FEBRERO 1984	6.13	3.37	-	0.85
JUNIO 1984	6.45	3.55	-	0.90
SEPTIEMBRE 1984	7.82	-	-	0.74
DICIEMBRE 1984	11.61	9.78	-	0.74
JUNIO 1985	16.00	9.78	-	0.74
OCTUBRE 1985	16.00	9.78	7.81	0.74
JUNIO 1986	16.00	10.79	7.81	0.74

FIGURA 4

EVOLUCION DE LAS RAZONES ENTRE PRECIOS POR LLAMADA LOCAL CORRESPONDIENTES A LOS DIFERENTES TRAMOS HORARIOS

EJEMPLOS CALCULADOS PARA 3 MINUTOS DE DURACION

FECHA DE CAMBIO TARIFA SLM	NUMERO DE TRAMOS HORARIOS	A/B	A/D	B/D	C/D	B/C
ABRIL 1981	DOS	-	4.25	-	-	-
DICIEMBRE 1982	TRES	1.60	6.40	4.00	-	-
OCTUBRE 1983	TRES	1.82	7.59	4.17	-	-
FEBRERO 1984	TRES	1.82	7.21	3.96	-	-
JUNIO 1984	TRES	1.82	7.17	3.94	-	-
SEPTIEMBRE 1984	DOS	-	10.07	-	-	-
DICIEMBRE 1984	TRES	1.19	15.69	13.22	-	-
JUNIO 1985	TRES	1.64	21.62	13.22	-	-
OCTUBRE 1985	CUATRO	1.64	21.64	13.22	10.55	1.25
JUNIO 1986	CUATRO	1.48	21.64	14.58	10.55	1.38

F I G U R A 5

ESQUEMA SIMPLIFICADO DE RED URBANA SANTIAGO (1)

(PLANOS DIGITAL Y ANALOGICO)

		DIGITAL							ANALOGICO									
		PP5	PP6	SL3	PRO	AP4	CH2	DPT	PP3	SL2	SI1	UA	AP	ÑÑ	PV	CH1	CIS1	SB
DIGITAL	PP5	-	x	x	x	x	x	x/ /CH2	x	x	x	x	x/ /AP4	x/ /PRO	x/ /PRO	x/ /CH2	x/ /CH2	x/ /CH2
	PP6	x	-	x	x	x	x	x/ /CH2	x/ /PP5	x/ /PP5	x/ /PP5	x/ /PP5	x/ /AP4	x/ /PRO	x/ /PRO	x/ /CH2	x/ /CH2	x/ /CH2
	SL3	x	x	-	x	x	x	x/ /CH2	x/ /PP5	x/ /PP5	x/ /PP5	x/ /PP5	x/ /AP4	x/ /PRO	x/ /PRO	x/ /CH2	x/ /CH2	x/ /CH2
	PRO	x	x	x	-	x	x	x	x	x	x	x	x/ /AP4	x	x	x/ /CH2	x/ /CH2	x/ /CH2
	AP4	x	x	x	x	-	x	x	x	x	x	x	x	x/ /PRO	x/ /PRO	x/ /CH2	x/ /CH2	CH2
	CH2	x	x	x	x	x	-	x	x	x	x	x	x/ /AP4	PRO	x/ /PRO	x	x	x
	DPT	x	x	x	x	x	x	-	x/ /CH2	x/ /CH2	x/ /CH2	x/ /CH2	AP4	PRO	x/ /PRO	x/ /CH2	x/ /CH2	x/ /CH2
ANALOGICO	PP3	x	x	x	x	x	x	CH2	-	x	x	x	x	x	x	x	CH1	CH1
	SL2	x	PP5	x	SI1	SI1	CH1	CH1	x	-	x	x	SI1	SI1	SI1	x	CH1	PP5
	SI1	x	x	x	x	x	x	x	x	x	-	x	x	x	x	x	x	CH1
	UA	x	PP5	PP3	SI1	SI1	CH1	CH1	x	PP3	x	-	SI1	SI1	SI1	x	CH1	PP5
	AP	x	x	x	x	x	CH1	CH1	x	PV	x	PP3	-	x	x	x	CH1	CH1
	ÑÑ	x	PP5	PRO	x	x	X	CH1	x	PV	x	PV	x	-	x	x	CH1	CH1
	PV	x	x	x	x	x	x	CH2	x	x	x	x	x	x	-	x	CH1	CH1
	CH1	x	x	x	x	PV	x	x	x	x	x	x	PV	PV	x	-	x	x
	CIS1	x	x	x	x	SI1	x	x	x	x	x	x	SI1	SI1	SI1	x	-	x
	SB	x	x	CH2	SI1	SI1	x	CH2	x	CH1	x	CH1	SI1	SI1	SI1	x	x	-

(1) NOTA: EN ESTE EJEMPLO SE HAN CONSIDERADO SOLO 17 CENTROS DE UN TOTAL DE 43.

FIGURA 6

RESULTADO OBTENIDO EN LA ENCUESTA DE SERVICIOS SUPLEMENTARIOS EN SANTIAGO

TIPO DE SERVICIO SUPLEMENTARIO	PRIORIZADO SEGUN DEMANDA	
	RESIDENCIAL	COMERCIAL
INDICACION DE LLAMADAS EN ESPERA	1	1
DESPERTADOR	2	8
REPETICION DEL ULTIMO NUMERO MARCADO	3	3
NO MOLESTAR	4	5
RETENCION PARA CONSULTA A OTRO NUMERO TELEFONICO	5	4
ABONADO AUSENTE	6	9
MARCACION ABREVIADA	7	2
TELETASACION	8	9
COMUNICACION EN CONFERENCIA	9	6

FIGURA 7

ESTIMACION DE DEMANDA POR TIPO DE SERVICIOS SUPLEMENTARIOS

TIPO DE SERVICIO SUPLEMENTARIO	CARGO FIJO MENSUAL (1985) (1)	DEMANDA INICIAL DE SERVICIO POR 100 LS. EN SERVICIO		TASA DE CRECIMIENTO ANUAL (%)	
		RESIDENC. (2)	COMERCIAL (3)	RESIDENC. (4)	COMERC. (5)
INDICACION DE LLAMADA EN ESPERA	$ 85	30	60	20	5
DESPERTADOR	60	20	10	20	30
REPETICION DEL ULTIMO NUMERO	130	10	35	30	20
NO MOLESTAR	150	5	20	30	15
RETENCION PARA CONSULTA A OTRO TELEFONO	190	5	30	30	20
ABONADO AUSENTE	720	5	5	30	30
MARCACION ABREVIADA	500	2	40	70	10
TELETASACION (1)	1.000	1	10	(1)	(1)
COMUNICACION EN CONFERENCIA	925	0.2	10	80	20

NOTA:

(1) EL SISTEMA DE TELETASACION SE UTILIZARA, POR RAZONES DE RESTRICCIONES TECNICAS, PRINCIPALMENTE PARA TELETASACION DE TELEFONOS RECAUDADORES AUTOMATICOS, PARA OBTENCION DE TARIFA INMEDIATA POR LLAMADA REQUERIDAS EN HOTELES, CENTROS DE LLAMADOS Y TELEFONOS PUBLICOS ADMINISTRADOS POR CONCESIONARIOS.

User Impediments:
Regulatory Restraints in an Era of Deregulation,
The Canadian Situation

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Abstract

This paper addresses the issues of service availability and user access in telecommunication services and systems from a Canadian perspective. It assesses the regulatory restraints imposed on Canadian users, reviews recent major telecommunications policy and regulatory decisions, and concludes that Canadian telecommunications users suffer from a myriad of regulatory impediments which have negative consequences for the entire nation.

1. INTRODUCTION

In 1835, the invention of the telegraph signalled Canada's entry into the telecommunications industry. Today telecommunications is big business. The industry currently employs over 100,000 Canadians; and the Gross Domestic Product in the telecommunications services sector is growing at a higher rate than the GDP for the overall economy. However, despite its past successes, there are those who question the ability of the telecommunications sector to meet the current and future needs of the Canadian user.

Recent telecommunications technological developments have created a myriad of opportunities for increasingly sophisticated business users to enhance their operating efficiency, market effectiveness and overall profitability. Like many other nations, Canada stands at the threshold of opportunity. The telecommunications industry has a critical role to play in economic expansion. Increased national productivity, regional growth and meaningful job creation are possible. However, there is growing evidence that Canada must act now to ensure its place in a world-wide information market place.

This paper will provide only a cursory review of the services and opportunities that are technologically feasible. It will focus, instead on three other issue areas from a uniquely Canadian perspective. First, it will discuss the potential benefits of the implementation of the services described for business users and for Canada. Second, it will analyze the Canadian telecommunications environment in terms of the prevalent policy and regulatory guidelines, and it will examine these guidelines in terms of the restraints they impose on users. Finally, it will discuss the consequences of these political and regulatory decisions for the Canadian economy and for Canada's future role in the Information Age.

2. WHAT'S AVAILABLE?

The telecommunications industry and the convergence of telecommunications with the computer have produced a vast range of innovative and exciting opportunities for the end users of these services. New carriage systems, including satellite, optical fibre, cellular radio, meteor burst, infra-red laser and other technologies, offer users a wide variety of options to the traditional public switched networks of the established telecommunications carriers. Digital transmission capabilities, packet switching and smarter computers have enhanced and supplemented these. Many new opportunities are available to users to individualize the technologies to meet their specific needs and objectives.

Technology makes a user-oriented system a reality. The following list provides only a brief introduction to the kinds of services now feasible.

- terminal attachments competition
- competition in long-distance toll services
- resale and sharing of dedicated lines
- private networks, local and long distance
- bypass of the public switched network
- teleconferencing and telecommuting
- data networks, teletext, videotext and data base services

- a variety of value-added and enhanced services
- personalized services
- mobile communications
- teleports

3. POTENTIAL BENEFITS OF COMPETITION

The benefits of competition and innovation accrue to four basic constituencies; the business user group is the most obvious of these. Costs can be markedly reduced. Ian Angus, president of Angus Tele-Management Group, Toronto, predicts savings to individual users of between 13% to 35% from the resale and sharing of dedicated lines.(1) D.A. Ford and Associates, in a study for the federal Department of Communications, have determined that the direct imposition of American long distances rates on the Canadian rate structure would decrease the business users' telecommunications expenditures by $675 million in 1986 alone.(2) Canadian rates are, on average, 13 per cent higher than American rates for comparable services. Some services are 37% to 52% more expensive.(3)

Competition also provides users with increased choice. These two factors, working in concert, can increase productivity and efficiency, and therefore, constitute an economic imperative for business users. Without a decrease in costs and an increase in productivity, Canadian business cannot match its foreign competition. Given the on-going free trade talks underway between Canada and the U.S., Canadian business cannot afford such a marked disadvantage.

The second class of big winners in a freer regulatory climate is the telecommunications carriers and suppliers. Increased supplier responsiveness and innovation, promotes the rate of technological diffusion which creates new opportunities and new revenues. Moreover, competition reduces the attractiveness of bypass alternatives and should prove profitable for many entrants.(4)

The average consumer can also be a beneficiary of changes in regulation. Lower prices for consumer goods and more choice in telecommunications services are good for all Canadians.

Finally, the sum total of all benefits accrue to the nation as a whole. By reducing costs and end user prices, the national standard of living increases. The telecommunications sector experienced a 52 per cent increase in exports to over $2,700 million dollars in 1984.(5) More innovation, supported by a freer regulatory environment can only foster this growth area.

In its application to the Canadian Radio-television and Telecommunications Commission (CRTC), requesting permission to compete with Bell Canada and B.C.Tel in the long-distance toll market, CNCP Telecommunications provided the following data. According to CNCP,(6) a 15 per cent reduction in long distance rates will have the following effects on the Canadian economy during the first five years of competition:

- The average annual Gross National Product will rise by $1.73 billion;
- Average annual employment will rise by 16,800;
- The rate of inflation will be lower by an average of .05 per cent each year;
- Real Disposable Income will be, on average, $199 million each year; and
- The Federal Deficit will be reduced by an average of $459 million annually.

Given these obvious benefits, most of which are acknowledged by both the CRTC and the Federal Government, what is the current state of affairs in the Canadian telecommunications environment?

4. THE REGULATORY ENVIRONMENT

Telecommunications regulation in Canada involves a number of regulatory agencies each of which directs different carriers in different parts of the country. This patchwork system evolved in response to the federal nature of the country and the constitutional ambiguity that surrounds the issue. However, the system has many critics and a settlement of the jurisdictional entanglement is viewed by many to be "... a necessary precondition for economic growth and development in all domestic industry".(7)

A federal review of telecommunications policy began five years ago. It includes an examination of telecommunications pricing, the impact of competition on telcos and users, and the impact of telecommunications on regional economic development. Four principles guide the review process in the determination of future policy decisions:

1. Universality must be maintained;
2. Canadian solutions must be sought;
3. The benefits of technology must be available to all Canadians; and
4. Canada must remain internationally competitive.

At the time of writing, no recommendations or policy guidelines have been formally announced. Many fear that time is running out. The avenues of opportunity for government action are small and delay serves only to exacerbate current problems and reduce the ability of Canadians to choose the future direction of their telecommunications industry.

One of the major roadblocks to federal action is the position of several of the provinces. Although nine of the provinces currently are working together with the federal government to find workable solutions, the success of their efforts is questionable. At a June meeting, the communications ministers agreed on the need for a "consistent" national policy but rejected options involving a "uniform" national policy. Just how one developes a national policy that is consistent but not uniform is an enigma.

The policies of the province of Saskatchewan are the most difficult to reconcile with the current state of technological development. In order to protect the provincial telco, SaskTel, Saskatchewan adamantly refuses to permit any rate-rebalancing or competition. It is one of only two provinces which still prohibits competition in the terminal equipment market. Not only does such a policy stance prevent end users in Saskatchewan from reaping the benefits of competition and innovation, but it also impacts on all Canadian users.

For example, as a member of Telecom Canada, SaskTel must be a signatory to an agreement permitting Telesat Canada to offer interconnected private-line service. This development will provide financial benefits to Telesat and to its customers who want to install private individualized networks. SaskTel is reluctant to sign the agreement because it fears bypass of its interexchange toll circuits and the resulting revenue loss. Such a position restricts the flexibility of the entire system.

To complicate the matter further, a recent legal decision questions the jurisdictional competence of the provinces to regulate telecommunications. The case involves CNCP Telecommunications and Alberta Government Telephones (AGT), Alberta's public telco. It arose out of CNCP's plan to offer long distance toll service in competition with Telecom Canada, of which AGT is a member. Both the trial and appellate courts found that AGT was an interprovincial undertaking (not an intraprovincial one, as it contended) and therefore, bound by federal law and subject to federal regulation by the CRTC. Although neither court ordered AGT to permit interconnection by CNCP, both agreed that AGT would be obligated by any CRTC decision in this regard.

The precedent set by these two courts is also likely to apply to other Telecom Canada telcos. An appeal to the Supreme Court is pending, but the provinces have a few options available to avoid a judicial determination of the issue. For instance, they can restructure the provincial telcos and establish separate companies for intra-and inter-provincial service or they can negotiate a jurisdictional settlement with the federal government. Regardless of the route taken the case is a significant one. It offers hope for the settlement of the telecommunications jurisdictional entanglement and the development of a coherent national policy.

5. USER IMPEDIMENTS

Competition exists to varying degrees in the Canadian telecommunications market place. Terminal equipment, enhanced services and cellular radio are examples. It is the public voice service sector which causes the most concern to suppliers, users and regulators alike.

Section 4 of this paper examined the Canadian regulatory framework and described how the inability of the system to achieve a consistent national policy inhibits telecommunications opportunities for users. In this section, a number of specific cases are investigated to highlight the restrictions Canadian telecom users must face.

Long distance toll service competition has been a reality in the U.S. for a few years, but Canadian regulators have not yet reached a definitive decision. Although CNCP Telecommunication's application to the CRTC to provide the service in direct competition with Bell Canada (Ontario and Quebec) and B.C. Tel (British Columbia) was rejected, in its decision the Commission recognized that competition in this service sector was inevitable. Officially the CRTC rejected CNCP's request on the grounds that the application was technically flawed. However, many believe that the CRTC was reluctant to radically alter the telecommunications environment without political support and/or direction. Whatever the reason, the decision disappointed many users who see it as a stumbling block to reducing their costs and enhancing their international competitiveness.

Many of these users had turned to long distance discounters such as Longnet, ETI Telecom International Inc., and Cam-Net to provide them with cheaper long distance toll service by rerouting their calls through American networks. Savings amounted to as much as 35 per cent. In response, BC Tel (in April 1985) and Bell Canada (in June 1985) applied to the CRTC to restructure their rates. Both received permission to increase short-haul rates and reduce long-haul rates for service to the U.S. This resulted in the shut down of most discounters.(8) The real losers were the users who once again were forced to accept Bell and BC Tel rates.

When the CRTC rejected CNCP's application for long distance telephone service, it suggested that other new services would be forthcoming to relieve the burden of users. The most heralded of these was the decision to allow companies to share and re-sell circuits and switches initially leased from the public phone companies. Users looked forward to pooling their lines, eliminating excess capacity, fine-tuning their communications networks and cutting costs. But a year later, Don Braden, president of the Association of Competitive Telecommunications Suppliers, believes that, "All these opportunities have been grinding to a halt."(9)

The basis for such pessimism in the face of the most liberalizing option ever offered users in Canada is the stance taken by the telephone companies. In their proposed conditions for resale and sharing submitted to the CRTC, the telcos have included a "facilities-based" restriction which severely limits the economic and practical feasibility of the service. Moreover, the CRTC has approved a telco rate structure which users criticize as so high as to wipe out any advantages which might have accrued to them. Cam-Net Communications Inc. believes that approval of the tariff structure means no resale or sharing opportunities will emerge.(10) Small and mid-size businesses will continue to want for telecommunications cost breaks. The entire situation is so disappointing that some critics are questioning the CRTC's entire mandate.

The position of the major telcos is the primary stumbling block to increased competition in the telecommunications sector. According to Peter Grant, "...the carriers have put forward an exaggerated increase in local rates on the basis of a hidden agenda either in order to stop competition or position local rates to (sic) that they confer a cross subsidy to the competitive sectors."(11) Their rate-rebalancing proposals create an unfair impression: the average consumer will pay more; big business will benefit most.

Moreover, the telcos continue to hold up the "bypass" issue as a reason for continued monopoly regulation. But a recent study by D.A. Ford and Associates Ltd. reports that bypass is not a strong threat. The study concludes that "Canadian telephone subscribers do not have a propensity to bypass domestic telephone company networks...".(12)

In addition to these major policy positions, critics argue that, in general, the telcos' pricing structures are designed to benefit the carrier at the expense of the user. Although the telcos like to appear competitive and innovative, they introduce new services in which the tariff structure wipes out the potential benefits of the services.(13) Furthermore, a number of charges have been made that the telcos are engaging in discriminatory practices against users who are searching for cheaper alternatives.(14) It is not the purpose of this paper to substantiate or refute these charges. However, they serve to indicate that an impression of inequitable practices exists within the user community.

Some attitudinal change on the part of the telcos is evident. In its 1985 Annual Report, BC Tel admits that increased competition is inevitable and claims to be devising a strategy to make its services "...so valuable to existing customers and so attractive to potential customers that would-be competitors will find market entry extremely difficult."(15) This attitude bodes well for the user, but Frank Feather, a consulting business futurist is less optimistic.

> Right now, Bell - with CRTC assistance - is robbing itself of increased income. In turn, this is ham stringing the business sector and robbing Canadian consumers of the benefits of the added value of the Information Age.(16)

7. THE CONSEQUENCES OF MAINTAINING THE STATUS QUO

The consequences of maintaining the status quo are staggering. The primary outcome will be evident in missed economic opportunities. Because telecom costs will be so out of step with costs in the U.S. and other countries, Canadian business will fail to thrive. In light of the current "free trade" negotiations, Canada cannot afford to be at such a disadvantage.

Another consequence of continued regulation and monopoly service is the lack of encouragement for innovation and research and development. Although the current technology is serving the needs of users, it will not continue to do so. Unless carriers and suppliers have an incentive to invest in the latest technology, Canada will find itself without the required telecommunications infrastructure.

> ...our telecom industry will become mediocre and globally noncompetitive. In turn, the business sector will lack a leading-edge "telecompunications" infrastructure. Our economy will suffer and the people of this "Land of the Telephone" will see no increase in their standard of living. Canada could become an "information poor", have-not country...(17)

Moreover, because of economies of scale, unless Canada acts now to prevent the erosion of our telecommunications system, we may find ourselves relying on American carriers and service providers. This loss of sovereignty in such a critical sector of our economy is unacceptable to most Canadians.

For the last five years, the Canadian government has spent thousands of dollars a year studying telecommunications, both the current situation and the potential impacts of change or maintenance of the status quo. While the studies continue, decisions are delayed. Delays mean missed opportunities which further exacerbate an already tense, confused and difficult policy environment.

8. CONCLUSION

Unquestionably, the solutions to the problems facing Canada's telecommunications environment present a difficult challenge. Despite evidence that continued regulation is an obsolete notion, there is strong opposition to rate-rebalancing and local measured service because of the appearance that few benefit. However Canadian governments realize that,

> Ultimately, Canada's economic stability rests to a significant degree on the ability of Canadians to compete in the domestic and international market place.(18)

All of these problems cannot be corrected in the short term, but recognition by both the public and private sectors is the first step to rectifying them. Not only should the telecommunications sector attempt to contribute to international trade in its own right, but it must also remain competitive within the domestic market. Costs need to be competitive if Canadian industry is to remain viable in terms of international trade. Moreover, the telecom sector must maintain its responsibility to individual Canadians who daily depend on basic telephone service.

The challenges facing the telecommunications industry and its regulators are critical to Canada's future social and economic development. The manner in which the nation meets these challenges will largely determine Canada's place in the rapidly evolving World Information Economy.

9. NOTES

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8. "Teleco Battles Against Upstart Toll Discounters Has Effect in British Columbia as Well as Bell Regions", Network Letter 5:36 (4 November, 1985), pp 1-2.

9. Financial Times of Canada, p. 8.

10. "X-Border Reseller, Consultant Condemn Proposals", Network Letter 6:30 (8 September, 1986), p. 2.

11. Peter Grant, Paper presented at the CBTA Seminar, Proceedings of Telecommunications in the Political Spotlight, 30 October, 1985, Toronto, Ontario, p. 5.

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13. Examples include the tariff structure for resale and sharing ("X-Border Reseller, Consultant Condemn Proposals", Network Letter 6:30 (8 September, 1986), p. 2); Bell's Digital Channel Service ("Bell Wins Approval for Digital Channel Service", Network Letter 5:12 (1 April, 1985), pp. 2-3); and the "floor" price for terminal equipment ("CRTC Confidence in Upcoming Cost-Related Ratings Enhanced with FCA Judgement in CNCP & CBEMA et.al.", Network Letter 5:23 (24 June, 1985), p. 3.).

14. See: "CRTC Seeks Comments on Bell Megaroute Tariffs", Network Letter 4:36 (5 November, 1984), p. 4.; "Bell Denies Charges of Preferential Cutover Times To Own Terminals", Network Letter 5:14 (15 April, 1985), p. 6.; and "ACTS v. Bell on Responsibility for Local Lines", Network Letter 6:17 (12 May, 1986), p. 3.

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Facsimile Communications via the International Public Switched Telephone Network

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Abstract

Thanks to the ease with which facsimiles can be connected to networks and put to immediate use in the transmission of documents to similar terminals anywhere in the world, facsimile communications utilizing the international public switched telephone network (PSTN) are currently growing at a very rapid pace.

Since 1982, KDD has been monitoring the volume of facsimile traffic using the international PSTN and conducting regular surveys of customers in order to obtain a clearer picture of the situation. KDD is using the data it has obtained in this manner to analyze the characteristics of this service and obtain a sound grasp of customers' future needs vis-a-vis the transmission of documents.

1. Introduction

Since facsimile communications allow actual letters and images to be reliably transmitted over telephone lines, they offer the following advantages over verbal transmissions:

1) speed

2) accuracy

3) lower costs

4) hard copy records of transmissions

5) a greater variety of automated functions.

Business was very quick to recognize the merits of the facsimile as a means of communication, and its use is rapidly spreading to small stores, small private enterprises and even into the home.

Recent advances in technology, too, have resulted in improved terminal equipment that makes facsimile communications even cheaper and easier to use. The facsimile is now viewed not so much as a specialized communications device but rather as a standard piece of office equipment.

Because of the large number of characters used in the Japanese language, and the difficulties involved in inputting them using keyboards, the facsimile has been particularly well-received in Japan as the best communications method available for transmitting text in the Japanese language. As shown in Fig. 1, the number of facsimiles in use in Japan has been increasing at an annual rate of over 50%. By spring 1985 the total number of units installed had topped one million, more than any other country in the world.

International facsimile services commenced in October 1980, with service available to some 29 nations. As of this writing (September 1986), services have been extended to include 76 countries, and the extraordinary growth in traffic volume has triggered a major increase in the use of international subscriber dialing (ISD) services.

Each year, KDD has conducted sampling surveys with a view to obtaining data on which to base analyses of the characteristics of facsimile traffic that utilizes the international PSTN. It has also conducted questionnaire-type surveys of facsimile users. In this way, KDD is making an ongoing effort to obtain a clearer picture of the actual state of modern facsimile communications and customers' needs with a view to developing even better methods of document transmission.

FIGURE 1

THE NUMBER OF FACSIMILES

	1979	1980	1981	1982	1983	1984
G 1 TERMINAL	27.400	28.100	24.700	22.000	19.000	16.400
G 2 TERMINAL	45.800	73.600	110.700	141.200	176.200	188.200
G 3 TERMINAL	25.600	36.800	67.800	148.200	291.300	525.900
TOTAL	98.800	138.500	203.200	311.400	486.500	730.500

FIGURE 2

PICTURE OF FACSIMILE TRAFFIC IN TELEPHONE USE

	1983	1984	1985
A(IN EUROPE)	70.6%	82.6%	72.2%
B(DITTO)	68.4%	81.0%	70.9%
C(IN N.AMERICA)	76.5%	74.9%	70.7%
D(DITTO)	70.5%	74.5%	68.8%
E(IN EUROPE)	66.8%	71.7%	66.1%
F(IN S.AMERICA)	--	69.0%	64.8%
G(IN ASIA)	56.9%	73.3%	63.5%
H(IN OCEANIA)	52.6%	57.1%	55.7%
I(IN ASIA)	54.2%	54.4%	54.7%
J(IN EUROPE)	55.2%	58.0%	53.4%
K(DITTO)	58.9%	58.8%	49.2%
I(IN ASIA)	40.8%	45.1%	43.2%
M(DITTO)	--	40.4%	42.5%
N(DITTO)	2.5%	20.4%	33.0%

(NOTE) -- IS NOT SURVEYED

2. Facsimile Communications Today

2.1 Facsimile Traffic

One study (see * below) analyzed international telephone calls made between 14 countries in Europe, Asia, Central America, with calls divided into voice and non-voice types. It was found that of the total number of calls originating in Japan, as much as 70% of the traffic to certain countries consisted of facsimile transmissions. The percentage of facsimile communications when averaged for the 14 countries reached 48%.

Most notably, facsimile traffic to nations in Asia has grown markedly in comparison with facsimile traffic to European nations. Once the use of facsimiles becomes more widespread in Asia and Africa, where equipment is still not readily available, it is clear that before long over half of all international telephone traffic will be devoted to facsimile communications.

Fig. 2 gives an overall picture of the use of facsimile traffic for each country covered in the study.

> * Note: This traffic survey was performed by monitoring outgoing international telephone calls originating in Japan that were switched through KDD's International Gateway station in Shinjuku, Tokyo.
>
> In this study, traffic to the 15 destinations referred to above was monitored during various time bands. Data on an average of 10% of the total calls made to each destination was automatically gathered by Automatic Observation Equipment developed by KDD, and stored on magnetic tape. KDD's Automatic Observation Equipment can distinguish between normal voice calls and non-voice calls such as facsimile or data transmissions with an average accuracy of over 94%.

2.2 Trends in Customer Use of Facsimile

As we have seen above, it is estimated that facsimile communications now account for some 48% of total international telephone call traffic originating in Japan. This growth in the use of facsimiles is radically changing the face of international communications. Customers who once had no choice but to rely on telex for the transmission of contracts and other documents, or telegrams for sending materials such as catalogs or blueprints, now have a cheaper, simpler, and more convenient way of sending documents. Not surprisingly, they are abandoning the more traditional methods of telex and telegram in favor of facsimile.

Fig. 3 depicts the changes that have taken place in one customer's telegram, telex, and telephone traffic since it commenced using international PSTN-based facsimile communications. Since 1985, when the customer in question started using international facsimile, its international telegram and telex traffic has evidenced a steady decline.

Further proof of this trend is provided by Fig. 4, which shows how a decline in the amount of international telex traffic from Japan to a certain Asian nation has been offset by an increase in facsimile traffic.

2.3 Characteristics of Facsimile Communications

1) Facsimile communications make use of ISD, which is economical in terms of charges. However, users do not attempt to take advantage of the cheaper rates offered at certain times of the day.

2) When customers use facsimile communications, they do so during Japanese business hours as the need arises and irrespective of the difference in time between Japan and the destination country. It can also be said that in general the content of these communications is not time-sensitive.

3) The volume of incoming and outgoing facsimile traffic each month appears to be approximately equal.

4) By region, North America accounts for 47.3% of the traffic, followed by Asia with 25.5%, and Europe with 22.0%. Together, these three areas account for 95% of all facsimile traffic.

5) Facsimile competes with airmail, electronic mail, and courier services as a means of transmitting documents internationally. Important documents such as contracts and materials such as photographs that require a high degree of image clarity are more often sent by methods other than facsimile. On the other hand, facsimile is more likely to be used for sending business communications (typed, printed or hand-written) for circulation within the same company.

3. What Customers Want from Facsimile

Thanks to the ease with which facsimiles can be connected to telephone networks and put to immediate use in the transmission of documents to similar terminals anywhere in the world, facsimile communications utilizing the international public switched telephone network (PSTN) are currently growing at a very rapid pace. Another factor that helped stimulate the rapid growth in the popularity of facsimiles was the establishment by CCITT of the international G1, G2, and G3 standards. This made it a lot easier for manufacturers to go into mass-production,

FIGURE 3 CUSTOMERS TRAFFIC TREND(FOR A COMPANY)

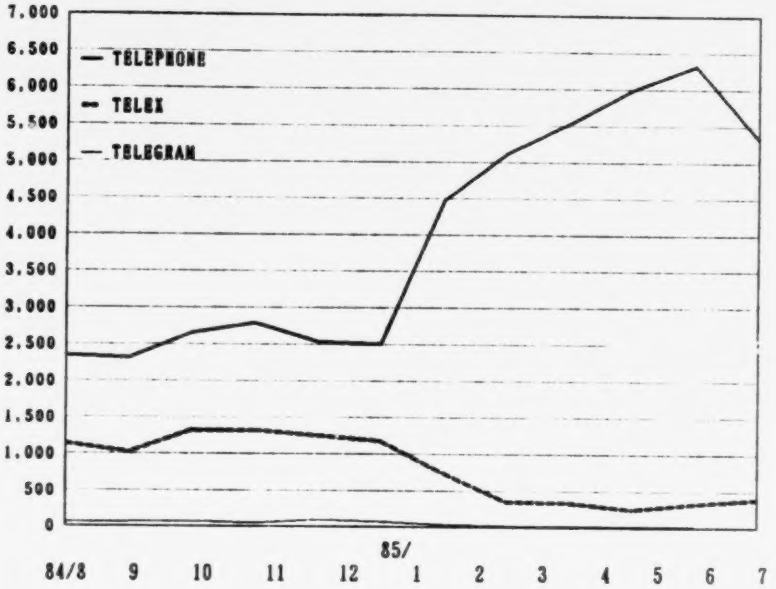
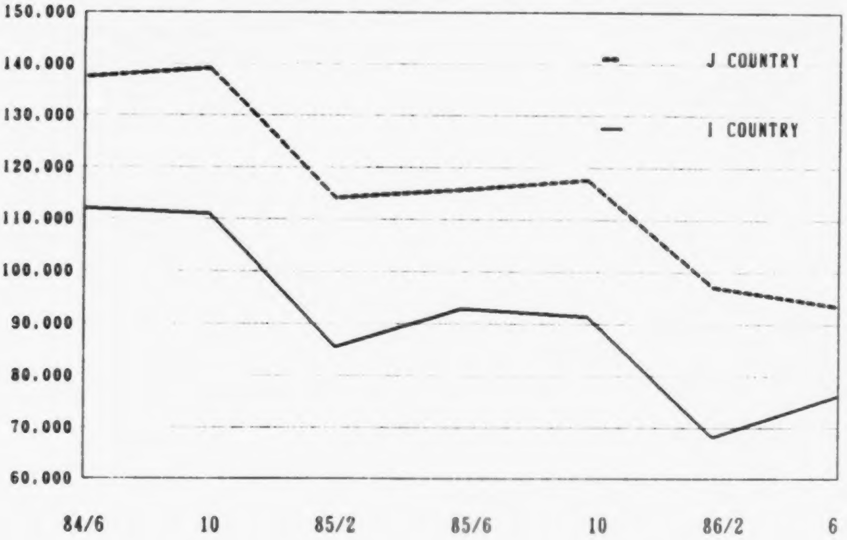


FIGURE 4 TELEX TRAFFIC TREND



causing facsimile prices to drop steadily from year to year.

However, with the increasingly widespread use of facsimiles and the growth in facsimile traffic, customers are beginning to discover that conventional facsimile communications have a number of weaknesses. Some of the problems often mentioned by customers include:

1) Transmission times are too long, the service lacks immediacy, and is costly when long distance calls are made.
2) Since there are no error-correction facilities, the quality of incoming images can be very poor.
3) Communications are limited to other facsimile terminals linked to the telephone network; it is impossible to communicate with a broader range of document transmission devices (for example, telex machines).
4) Customers would like the telephone network to offer value-added services such as store-and-forward transmissions and variable transmission speeds, etc.

Seen from another angle, however, demands for high-level facsimile communications that overcome these weaknesses are very likely to provide the basis for new services.

4. Development of New Services

4.1 International Facsimile Transmission Service

KDD plans to introduce an international store-and-forward Facsimile Transmission Service in conformity with CCITT Recommendation F.162.

Outgoing as well as incoming facsimile messages can be handled economically for customers of the service if both carriers introduce a facsimile switching system which can be directly connected to the KDD Facsimile Switching System.

The Facsimile Switching System shall be built on the basis of the CCITT standard X.400 series recommendations, taking into account the potential capability to directly interconnect with other facsimile switching systems.

The Facsimile Switching Service enables a customer's G3 facsimile station to communicate with another station located in a foreign country, using the national PSTN and a dedicated international line.

The Facsimile Transmission Service will be initiated around July, 1987.

4.2 International Circuit-Switching Service (VENUS-C)

There is an increasing need for international public data transfer services based on circuit switching, which is well-suited to the exchange or transfer of large volumes of information, such as facsimiles and file transfers.

KDD plans to introduce an International Circuit-Switched Data Transmission Service (VENUS-C) to meet new demand, such as the requirement for high quality, high density digital facsimile type transmissions.

VENUS-C is positioned as a complementary service to VENUS-P (International Packet-Switched Data Transmission Service), and the VENUS-C system will be integrated into ISDN in future.

VENUS-C will go into service in October, 1987.

5. Concluding Remarks

As society becomes increasingly information-oriented, we are very likely to face growing demand for more sophisticated, more diverse document transmission services.

As our past research has shown, the needs of customers who currently make use of facsimile communications that utilize international PSTN are not necessarily being entirely satisfied. KDD has already initiated measures to cope with this situation by developing new services such as the International Facsimile Transmission Service.

Still, it is only natural that, in the face of the rapid changes occurring in modern technology and environmental conditions, our customers should be constantly demanding newer and better communications methods and services. KDD's task is to anticipate customers' needs and push ahead with a program of technological development that will allow it to provide new services in a timely manner.

Technological Self-Reliance in Korea Telecommunications

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1. ABSTRACT

Telecommunications is a tool providing information services for both private and public sectors. Furthermore, it has now close linkages with formerly unrelated areas of technologies as telecommunications is fused with computer technology. Countries with an aspiration of technological self reliance in support of the forthcoming information society have recognized the important role of indigenous technological capability. The case of Korea with its attempts to achieve the technological self-reliance in telecommunications sector is discussed.

2. INTRODUCTION

Acquisition of telecommunications systems in Korea has heavily relied on foreign sources. Korea has attempted to minimize this dependence on foreign sources and to stimulate the development of indigenous technologies. Is it then a viable proposition for Korea to attempt to develop its own technology in such a research and development(R&D) intensive area?

The rationale for the Korean efforts rests on following assumptions.

Firstly, it would increase the technological capability in a key sector of the economy of a nation such as telecommunications and be a way of providing the necessary infrastructure for the introduction of advanced telecommunications services. Secondly, technological dependence on foreign sources, and thus a heavy reliance on foreign technology implying repetitive import of technology in the sector, would diminish. Thirdly, the cost of acquiring technology especially in terms of foreign exchange would diminish, at least in the long run, by the substitution of import for local production and by export earnings. Furthermore, enhanced indigenous technological capability provides Korea with a stronger bargaining power in negotiatiing with the foreign suppliers, which will ultimately be reflected in better condition of technology tansfer and lower cost of system acquisition.

3. AN APPROACH TOWARD SELF-RELIANCE

R&D efforts in Korea telecommunications sector is of fairly recent years. Prior to the 1980's, the dominance of imported or licensed product in the sector had resulted in an almost total lack of industrial R&D capabilities. It was not until the restructuring of the public telecommunications sector by Ministry of Communications(MOC) in the early 1980's and the consequent transfer of government operated telecommunications services to a public corporation, Korea Telecommunication Authority(KTA), that the need for technological self-reliance in the sector became critical. Some R&D activities had been carried out, mainly by the universities, but no coordination to the needs from telecommunications industry existed.

Even if the environment in the telecommunications service sector changed, there were no indication that an automatic adjustment towards closer links between industry and universities, and increasing R&D activities would occur. One of the first tasks facing KTA after its creation was thus to construct the R&D infrastructure in telecommunications sector.

Recognizing the lack of R&D capability in Korean industry, KTA turned to the only available R&D resource at the time universities - and supported the creation of R&D environment consisting of Korean scientists and engineers from overseas who have been working within their area of interest. The major reason for supporting these groups at the time was not so much strictly to achieve industrial goals,i.e. to develop marketable product, but rather to develop human resource in telecommunications sector. The creation of Electronics and Telecommunications Research Institute(ETRI) was a first step toward indigenous and self-reliant technological capability, but it was also evident that such an institute could not function without strong financial support and proper management, but needed to be reformed in an objective-oriented R&D environment.

KTA took the step to support R&D activities also in industry. Industries were supported by KTA to develop specified equipment such as coin telephone set, digital switching system and fiber optical transmission system, etc.

By supporting R&D activities at ETRI and industry, KTA hoped that they would function as the center of excellence facilitating the indigenization of R&D efforts in Korea telecommunications. Before such a development could be envisaged, however, one element was missing; a link between network operating group of KTA, ETRI and industry. Furthermore, no institute existed that could carry out R&D effort beyond the immediate interest of industry.

In order to fill this gap, KTA Research Center(KTARC) was created in 1984. The main objective of KTARC is to build a technology base in support of the country's needs and to absorb and adapt foreign technology according to the country's needs. Apart from carrying out in-house R&D, KTARC has a coordinating function providing guidance and technical support to network operating group and industry based on the policy set forth by KTA. The university group, which currently receives the most of R&D funds from Ministry of Science and Technology (MOST), carries out both basic and applied research. Another important objective for the university group is human resource training by offering higher education in the telecommunications field.

The support of R&D in industry is aimed at building-up R&D infrastructure in industry and facilitating product/prototype development.

A unique entity in R&D infrastructure in Korea telecommunications is the Program Management Office(PMO) of KTA which serves the functions of R&D management and operational test and evaluation of the systems developed by ETRI and/or industry.

R&D activities are carried out in cooperation with the various entities of R&D infrastructure according to the following schemes;

* Policy and Funding: MOC,MOST and KTA
* Basic Research: Universities and Research Institutes
* Applied Research: Universities, Research Institutes,ETRI and KTARC of KTA
* R&D Management: PMO of KTA
* Quality Assurance: QA Office of KTA
* Operational test and evaluation: PMO of KTA
* Prototype Development: ETRI and Industry
* Product Development: Industry and ETRI
* Production: Industry.

At present, R&D infrastructure is still in a building-up phase. ETRI aims its resources at implementing R&D infrastructure in support of industry which means that major responsibility of the product development is still very much a matter for ETRI. However, in order to promote R&D activity in industry, participation of industry from the beginning narrows the gap between research laboratories and manufacturing process. By including industry earlier in R&D phase, more and more of R&D activities will be handed over to industry, as the technological capability in industry grows.

Sometimes a company is awarded a contract to develop a system not because it is good at doing it, but because KTA wants technologies to be developed in industry. Thus, as the capability of industry grows more and more complex system will be developed by industry on its own. Much of the work performed by ETRI will be taken over by industry, leaving ETRI to move into high-risk R&D and advanced technology support. The major areas of R&D at ETRI are digital switching, optical communication, digital transmission, data communication, satellite communication, VLSI, and electronic components and materials.

In 1987, the total R&D investment by KTA is around 70 million US dollars, around 60 % of which were allocated directly to ETRI. The most comprehensive program at the moment is TDX(a digital switching system) development which shares around 30% of its total R&D budget. TDX family consists of TDX-1 with a capacity of 10,000 subscribers and TDX-10 with a capacity of 100,000 subscribers.

Moving from the relatively unsophisticated TDX-1 to TDX-10 includes moving up to higher degree of complexity. TDX-1 systems have been produced since 1985 and are in service. TDX-10 system is now under development and will be in service from the early 1990's. The TDX family concept thus makes it possible to gradually improve the technical capability of every entity in the R&D infrastructure by dedicating all the effort to successively more complex systems. This strategy is also aimed at simultaneously achieving the goal: indigenous development of telecommunications systems specifically toward an Integrated Services Digital Network(ISDN) in the 2000's.

4. CONCLUSION

It must be recognized that achieving the technological self-reliance in Korea telecommunications is a time consuming process. The sophisticated nature of telecommunications systems indicates that the cost of a lengthy learning process in the sector is also very high. Therefore, it is always necessary to consider both cost and milestone involved in the attempts to develop a self-reliant telecommunications technologies. Korea is one of a few developing countries that satisfies basic requirements for venturing such a task. It has a growing market home and abroad for telecommunications systems. It has well defined national policy and well organized development systems for implementing an ISDN. And finally, it has ever growing aspiration of capability in terms of experience and human resource on which to develop Korea indigenous telecommunications systems.

SESSION 4
Technical Applications

EFFECTIVENESS AND PROBLEMS OF INFORMATION NETWORK SYSTEM USING DIGITAL TECHNOLOGY

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1. Abstract

In 1984, Fujitsu launched a three-year project to build an inhouse information network system, using new common carrier(NCC) and Nippon Telegraph and Telephone Corporation(NTT) high-speed digital technology. By digitizing and integrating conventional leased-line analog system, installed for different, specific applications, into a single digital system, Fujitsu worked to cut communication costs and to improve service quality and line efficiency. The network, which originally linked only six company offices and factories, will link 95 domestic company facilities as of March 1987. The service network is expanding and the types of services supported are increasing. These include video conferencing, a value added network(VAN), and high-speed data transmission.

2. Introduction

Networks that meet the needs of an information-oriented society are becoming increasingly important. To be successful, business management must be able to repidly and accurately retrieve both information generated in-house and that being passed between different enterprises. This requires that networks be capable of efficiently handling a wide range of data, including audio, text, and video data. This flexibility is of prime importance.

A standard protocol is indispensable to the infranstructure of such networks, and multiple online systems must be able to be interlinked This directly improves the quality of such networks as these networks are increasingly used, improved line operating efficiency and network security have become paramount.

To meet these diverse needs, NTT began a high-speed digital leased-line service in November 1984. This service will form the infrastructure of networks in the years to come. A total of 1014 lines are being leased by 196 corporations in Japan. Another 334 corporations have applied for an additional 2073 lines. The volume of information has grown 1.5 to 2.5 times and lines are actively being used. Fujitsu was the first user of the high-speed digital leased lines and, itself, introduced value-added network services (FENICS) on October 1, 1985. Fujitsu provides this service as Type I Telecommunications Business under the Telecommunications Business Law promulgated on April 1, 1985.

Fujitsu is working toward developing a Fujitsu Total Network--an information network system having the following basic objectives:

- Development and operation of network systems associated with distributed, enhanced OA and EDP systems
- Development of efficient network operating procedures and accumulation of knowhow and experience through network systems actually run inhouse
- Substantial reduction of communication costs
- Development of an infrastructure for highly reliable VAN systems and networks

This paper reviews in detail, the experience gained by Fujitsu personnel in developing and operating information network systems. This paper also discusses problems indentified during this process.

3. System Overview

3.1 Network Configuration

Fujitsu's information network system integrates and digitizes conventional analog networks--which requied separate networks for different media--into a single digital network system to improve line efficiency, service, and network reliability. As the first step, plans called for linking six facilities when the network was launched in December 1984. In the second step, the number of facilities was increased to 39 in 1985, with 50 more facilities to be added gradually to the network in 1986, bringing the number of facilities linked by the digital network to 95.

The network includes a digital multimedia multiplexer(DMIX) installed at each facility to process different types of data, such as toll dialing, facsimile, data and video connected through digital switching systems; packet switching systems; image code transmission devices; video switching systems; and other state-of-the art devices.

The network has a total of 113 leased lines (total speed: 188 Mbps). In addition to NTT lines, the network uses leased lines provided by new common carriers(NCC). Details are given in Table 1. The circuit configuration is given in Figure 1.

Conversion from the conventional analog network was done a step at a time. First, trunk lines were converted using overlays. Local lines were then digitized, one after another. This approach appears the most effective from the viewpoint of deploying telephone, data communication, and other services. In the more to digital networking efficiency and reliability from the viewpoint of network design were the main considerations for data flow, line concentration, economy, maintainability, and expansion.

3.2 Services

The overall network system supports in-house intragroup, and VAN services, and meets the needs of these individual services.

(1) In-house telephone network
The in-house telephone network is a three-level hierarchy that provides 95 facilities with toll dial services. The network operates using the ADPCM recommended by CCITT to improve digital line efficiency because audio data accounts for much of the data processed by digital networks. Audio data quality has been maintained by adopting a digital one-link configuration and 32K bps transmission mode, 16K bps compression has been introduced in part and is undergoing testing. The in-house telephone network is given in Figure 2.

(2) Data communication network
Requests for EDP, OA, CAD, and other types of online systems are increasing at about 20% a year. Communication lines for these applications are centralized at data processing centers and about 1000 lines--which make it a large-scale network--are currently in use. The network itself is configured from dedicated lines and packet switching networks. When network functions and response are of prime consideration, dedicated lines are recommended. Single terminals can be shared and multihost access is supported: therefore, the packet switching network is used as the major shared network in the system. High-speed lines (over 48K bps) are used when high-speed data transfer and short response time are required, such as in high-speed file transfer between hosts and CAD terminals.

A long-distance high-speed file transfer test was run to check the effects of the unique features of digital lines on data communication. The monitoring-timer setting for the HDLC protocal, and the retry count were set at levels to optimize data recovery. This measure was taken for the furst error (50-100 ms) unique to digital networks.

This type of data communication network is given in Figure 3.
This configuration of the packet switching network is given in Figure 4.

(3) Video switching network (Teleconferencing)
Teleconferencing linking multiple sites uses a wide-band digital exchange implemented in combination with a 768K bps band compression device. The system operates linking ten major facilities. Reservations are required fro the teleconference service. Personal computers are used for reservation management and remote control of connection between two facilities.
The teleconference network configuration is given in Figure 5.

(4) Linking international networks
The international network consists of international voice-grade leased lines linking San Jose, London, and Fujitsu's Kawasaki Factory. Telephone, data, and FAX communications are supported. The network is also linked with domestic digital networks.

(5) FANICS VAN service
The Fujitsu Enhanced Information and Communication Service(FENICS) was introduced in October 1985. There are 89 access points(APs) in branch offices scattered around the country. The two data-processing centers are located in Tokyo and Osaka.

The major objectives in developing the VAN network are as follows:
i) Superior service and operating efficiency
ii) Comprehensive monitoring and easy billing and other procedures
iii) Measures for ensuring reliability, dual-route trunk lines, and bypass lines

To improve reliability, some system devices have been duplicated and an in-house power generator installed in case of power failures. At the end of 1986, the FENICS network had 5000 corporate subscribers and 20000 terminals. The system's major services include other entry services mainly involving data exchange, a remote computing service(RCS), and a database access service. The FENICS network configuration is given in Figure 6, and services are in Figure 7.

(6) Linking companies in a corporate group
To improve operating efficiency in the Fujitsu group, the network service was extended to all companies in the Fujitsu group. In the early stages, emphasis was on telephone and data communication. Twenty companies were linked through the information network system in 1986.

4. Advantages of Network Implementation

Digital networks are important as an infrastructure of information network systems and contribute to improved service, economy, quality, and other aspects.
In the network above, the use of information resources has been optimized and enhanced communication services and office automation systems have been distributed throughout the company.

4.1 Network Use Status

(1) Toll dial network

Trunk line charges have been cut considerably compared to those for conventional lines. This, in turn, has made it possible for many departments in the company to join the toll dial network, spreading toll dialing quite rapidly through the company.

- i) The "line busy" rate has been cut to below 10%.
- i) The number of toll dial offices has increased from 54 to 107, making it possible to provide a 24-hour extension (line) services.
- i) The digital one-link service provides high-quality long-distance communication lines.

Toll dial use status is given in Figure 8. As the figure indicates, the number of facilities linked by the network is double that in conventional networks. The number of trunk lines (channels) has also been doubled, and the network has been able to keep up with growing requests for communication services.

(2) Data communication network

The data communication network has been configured from companywide packet switching network and leased communication lines. The data communication network is being used for office automation services such as electronic mail and database access; EDP services such as order placement and reception and production control; and CAD. A single packet line terminal serves as both an OA and EDP terminal. The delay mode in the packet switching network is 0.6 s. For CAD terminals, dedicated lines are used to increase speed and shorten response time.

Local area networks(LANs) having loop and star configurations are implemented between the head office and individual factories to increase line concentration and simplify cable laying.
Two types of synchronous interface systems--1 a highly-reliable independent system and 2 a master-slave system--are generally used to interconnect LAN and digital networks. Our system uses the Rb.OSC (Precision $1x10^{-11}$) system (type (1)).

Data communications network use status is given in Figure 9. The number of terminal lines is shown for reference for the packet switching network.
As the figure also indicates, requests for data communication lines have nearly tripled.

(3) Video conferencing and video data relay

This service is new. At this point, the ten most important facilities of the company have been linked through video data transmission lines (768K bps compression). This service is being used between far-flung facilities to hold teleconferences.
This service is used an average of 9-12 times a day and has provided the following benefits:

- Speeded-up decision-making
- Decreased travel time and reduced communication casts

The use status for the video conference system between major offices is given in Table 2.

(4) FENICS Network

FENICS provides VAN centers located at Tokyo and Osaka, plus 89 APs distributed in major cities around the nation. The network shares the company's digital network to form an economical system.

There remian problems in the original FENICS network:

(1) Lines were not used efficiently because most lines were used as dedicated.
(2) Operation and maintenance are becoming very difficult because of the complex circuit configuration.
(3) AP configuration takes a long time because additional circuit installation was necessary for every AP configuration.
(4) There were no alternative routes in case of line failures.

The packet switching network was introduced to help overcome the above problems.
Now, networks can be shared, operating efficiency can be increased, and the system can be expanded quickly by simply laying additional line sets.
Because digital line costs could be reducted, the network configuration became more flexible:

- Setting up of trunk-line bypass routes
- Duplicated configuration of lines and devices

4.2 Economizing on Line Charges

A comparison of costs for building the current network with analog lines and the cost incurred by the introduction of digital lines is given in Figure 10.
One of the major advantages of introducing the digital network is the reduction of line charges by replacing analog lines with digital lines.
The number of lines increased due to reduced line charges, we estimated the advantages by comparing the costs of digital lines and analog lines.

Compared with the number of lines in Figures 8 and 9, the cost per line has been cut by about 20 to 30%.

5. Operating Management Problems and Countermeasures

Despite the many advantages of digital network systems, there remain a number of problems:

5.1 Differences from Conventional Analog Networks

In addition to lowering costs, other objectives in installing high-speed digital networks are as follows:

- Digitally transmitting voice, data and video increases quality and communication speed.
- Communication equipment required for different media can be integrated and shared.
- Integrating communication lines and equipment can reduce network operation and maintenance costs.

Although the digital network has, indeed, provided the above advantages, it has the following problems:

(1) The effectes of a problem in a communication line or system equipment, such as multipurpose lines, are much more widespread than in analog lines. Troubleshotoing also takes much longer.
(2) By multiplexing the conventional analog lines and using them for multimedia transmission, the operation of communication liens (Planning, design, installation, maintenance of communication equipment, customer management, billing) previously done by the common carrier must now be done in-house.
(3) Management was divided based on the medium. That is, responsibility of the General Affairs Division and data communication was the responsibility of the EDP Division.
However, a single, centralized management organization for all media is required.

As the network grows, the service area and hours grow. The introduction of round-the-clock, year-round service will require that the original management and operating organization be revamped.

5.2 Line Failure and Effects on Users

Line status and line trouble occurrence, which can be used as a reference in evaluating the quality of the digital line network, are given in Figure 11. The digital lines in our network have been operating 691 months. Problems developed 65 times during this poried, meaning that line trouble occurred at 0.1 failure/month. Mean time to repair (MTTR) was 151 minutes, indicating that line troubles tend to last a comparatively long time. Particularly when a trunk line problem occurs, effects spread to FENICS, the in-house online system, telephone service, and other areas.

Causes of failures are listed in Table 3. Note that reliability has been raised markedly by improving subscriber microwave equipment, introducing more stable equipment, and taking other measures.

Note that raliability is one of the most important requirements of FENICS. We responded to this requirement as follows when designing the network:

(1) Provision of an alternate route (route duplication)
Trunk routes have been duplicated in 64K bps channels so that, if a line problem occurs, lines are switched and service is not interrupted.
(2) Provision of an alternate subscriber line to data processing centers (duplication of subscriber lines)
Subscriber lines to the FENICS center are configurated on independent routes and systems by the combined use of NTT and NCC lines.
(3) Provision of standby equipment (device duplication)
The shared parts of communication equipment are duplicated.
(4) Power equipment
ALL facilities have CVCF systems that provide a stable power supply with a battery backup for transient and temporary power failures. Data centers provide in-house power generation equipment for supplying power during extended power failures.

5.3 Operation Management (Organization)

In the conventional management organization of network systems, each system is managed independently. A specialized organization is required to manage a nationwide, shared network such as ours. Thus far, the VAN Systems Division has been responsible for digital network planning, design, and construction. A new organization is now developed for network operation, with emphasis being put on the training of network operators and the establishment of an information route based on the current organization.
The digital network operation organization is given in Figure 12.

5.4 Development of Network Management System

Development of a viable network management organization and an operation management system have become important factors, along with expanding network equipment and growing service area.

A system design having the following functions is being promoted from the viewpoint of centralizing management at the network center, improving the efficiency of network operation, and reducing the number of personnel.

- Operation monitoring: Centralized operation monitoring status display
- Monitoring: Centralized troubleshooting, identification of possibly faulty circuits and equipment
- Quality control: Error rate, transient failures, occurrence of problems
- Control: Loopback testing, line switching
- Work control: Work planning and adjustment
- Line management: Line use status, line configuration
- Traffic management: Concurrent line operation rate, statistics
- Display/Monitoring: Primary display (Graphics screen), secondary display (CRT screen)
- Billing: Billing data collection user management

Network monitoring and management is given in Figure 13.

6. Problems

The three-year digital network construction project will end with fiscal 1986. The network itself will continue expansion and modification in response to growing requestes. The problem of reducing line costs by improving line efficiency remains. It must be considered along with the following:

- Improvement in overall network monitoring and evaluation
- AI-based diagnostics
- Dynamic network switching
- Improved network security

7. Conclusion

This paper briefly described Fujitsu's digital network as a model of a corporate information network system. The network continues to be enhanced to improve service and the level of functions supported.
Network systems such as ours are expected to become more advanced and diversified over time. Improvements in network reliability and security will have to keep pace with the above changes.

Table 1 HIGH-SPEED DIGITAL LINE

Speed	Number of lines
6 Mbps	2 0
1.5 Mbps	2 7
768 Kbps	1 5
384 Kbps	3 1
192 Kbps	2 0
Total	1 1 3

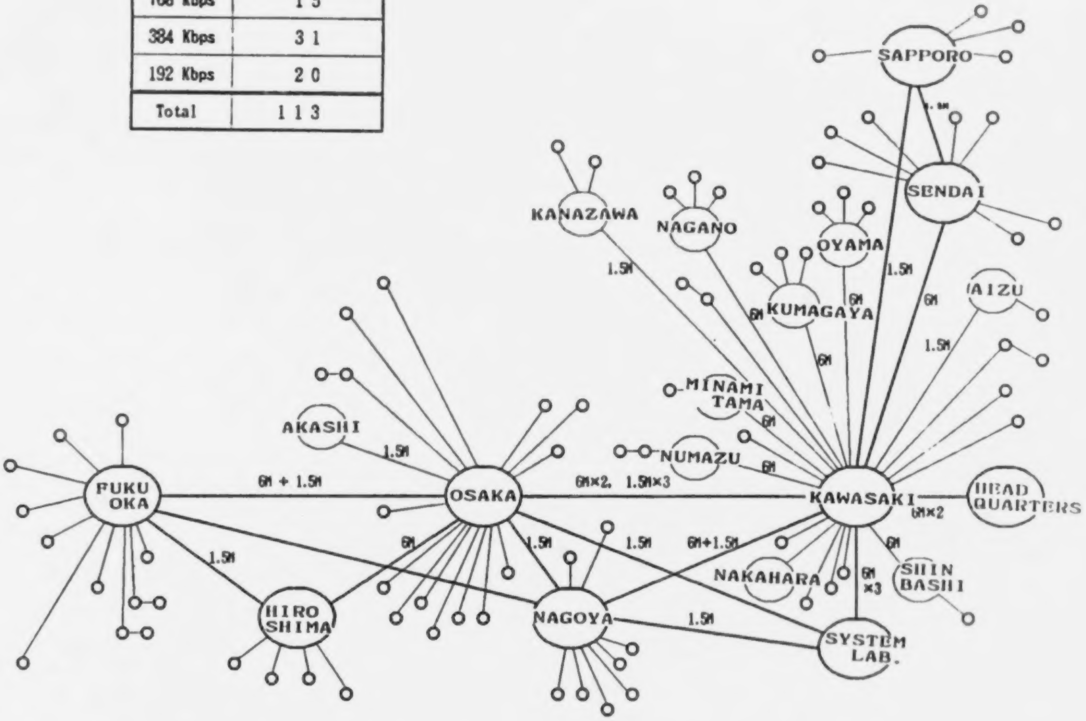

SAPPORO
SENDAI
KANAZAWA
NAGANO
OYAMA
KUMAGAYA
AIZU
MINAMI TAMA
NUMAZU
AKASHI
FUKU OKA
OSAKA
KAWASAKI
HEAD QUARTERS
HIRO SHIMA
NAGOYA
NAKAHARA
SHIN BASHI
SYSTEM LAB.
6M + 1.5M
6M×2, 1.5M×3
6M×2
1.5M
6M
6M+1.5M
6M ×3

Figure 1 CONFIGUATION OF FUJITSU DIGITAL NETWORK

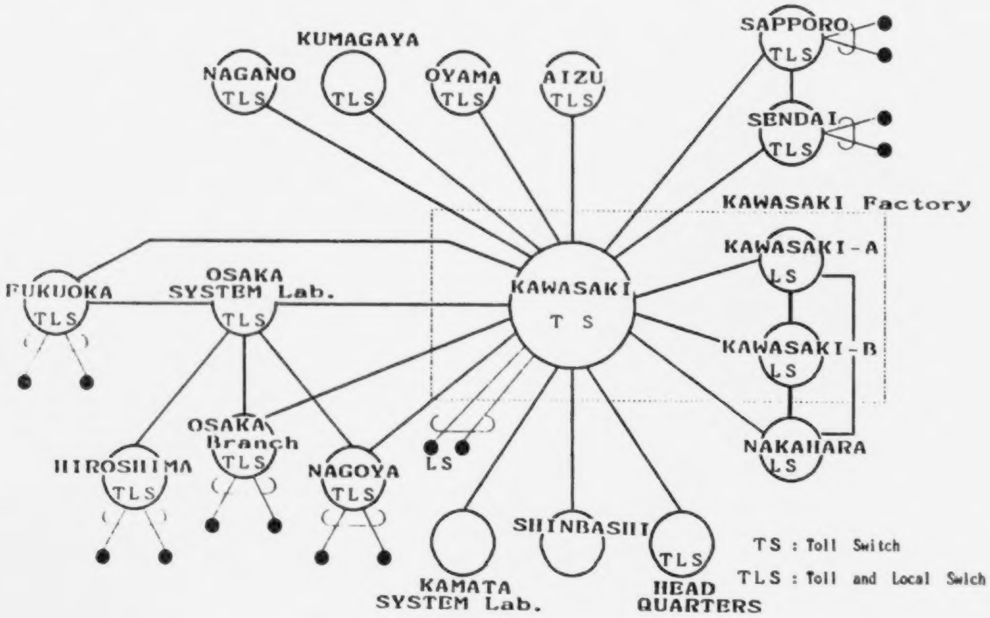

KUMAGAYA
NAGANO TLS
TLS
OYAMA TLS
AIZU TLS
SAPPORO TLS
SENDAI TLS
KAWASAKI Factory
KAWASAKI-A LS
KAWASAKI-B LS
NAKAHARA LS
FUKUOKA TLS
OSAKA SYSTEM Lab. TLS
KAWASAKI T S
HIROSHIMA TLS
OSAKA Branch TLS
NAGOYA TLS
LS
KAMATA SYSTEM Lab.
SHINBASHI
TLS HEAD QUARTERS
TS : Toll Switch
TLS : Toll and Local Swich

Figure 2 CONFIGURATION OF PRIVATE TELEPHONE NETWORK

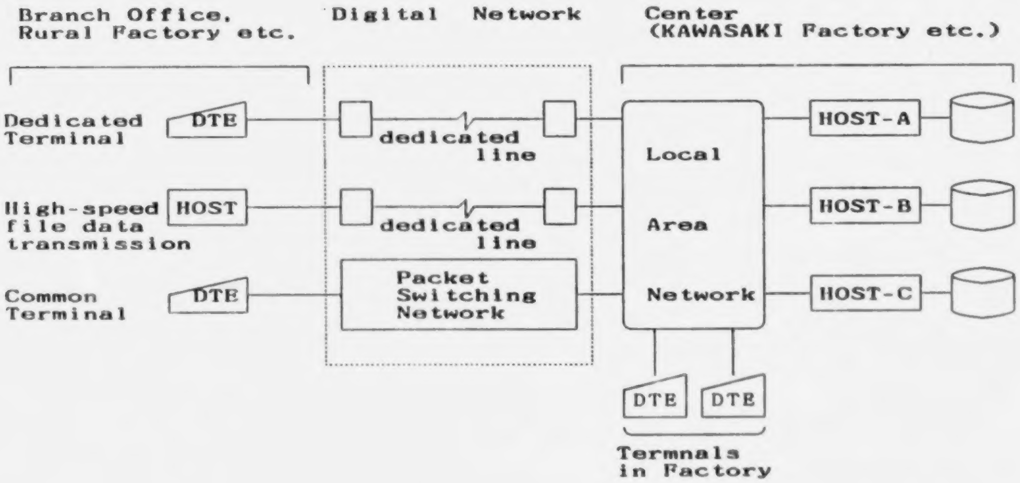

Branch Office. Rural Factory etc.
Digital Network
Center (KAWASAKI Factory etc.)
Dedicated Terminal
DTE
dedicated line
High-speed file data transmission
HOST
dedicated line
Common Terminal
DTE
Packet Switching Network
Local Area Network
HOST-A
HOST-B
HOST-C
DTE
DTE
Termnals in Factory

Figure 3 OUTLINE OF DATA COMMUNICATION NETWORK

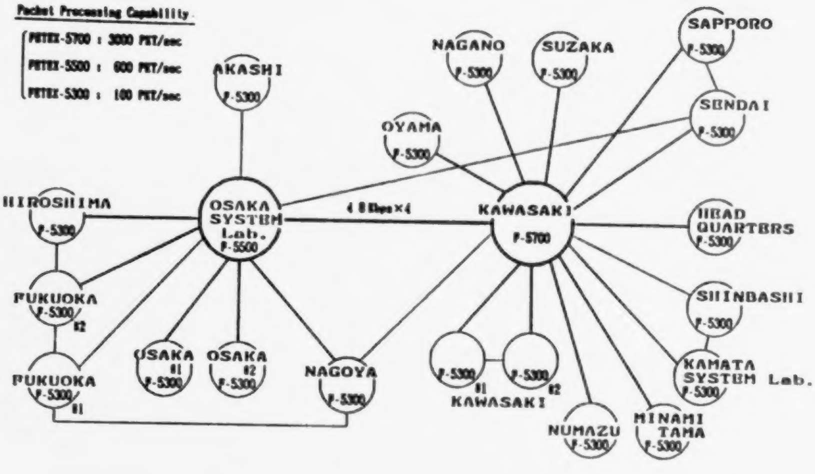

Packet Processing Capability
FETEX-5700 : 3000 PKT/sec
FETEX-5500 : 600 PKT/sec
FETEX-5300 : 100 PKT/sec
AKASHI
P-5300
NAGANO
P-5300
SUZAKA
P-5300
SAPPORO
P-5300
SENDAI
P-5300
OYAMA
P-5300
HIROSHIMA
P-5300
OSAKA SYSTEM Lab.
P-5500
48Kbps×4
KAWASAKI
P-5700
HEAD QUARTERS
P-5300
FUKUOKA
P-5300
#2
SHINBASHI
P-5300
OSAKA
#1
P-5300
OSAKA
#2
P-5300
NAGOYA
P-5300
P-5300
#1
P-5300
#2
KAWASAKI
KAMATA SYSTEM Lab.
P-5300
FUKUOKA
P-5300
#1
NUMAZU
P-5300
MINAMI TAMA
P-5300

Figure 4 CONFIGURATION OF PACKET SWITCHING NETWORK

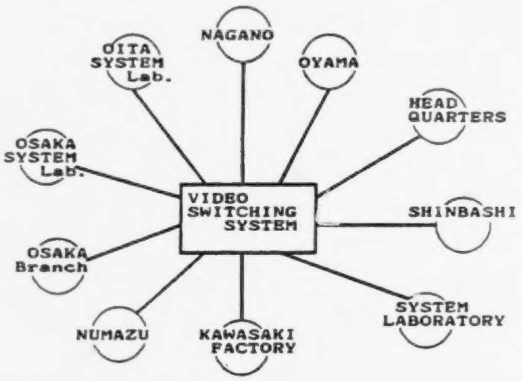

OITA SYSTEM Lab.
NAGANO
OYAMA
HEAD QUARTERS
OSAKA SYSTEM Lab.
VIDEO SWITCHING SYSTEM
SHINBASHI
OSAKA Branch
SYSTEM LABORATORY
NUMAZU
KAWASAKI FACTORY

Figure 5 CONFIGURATION OF TELECONFERENCE NETWORK

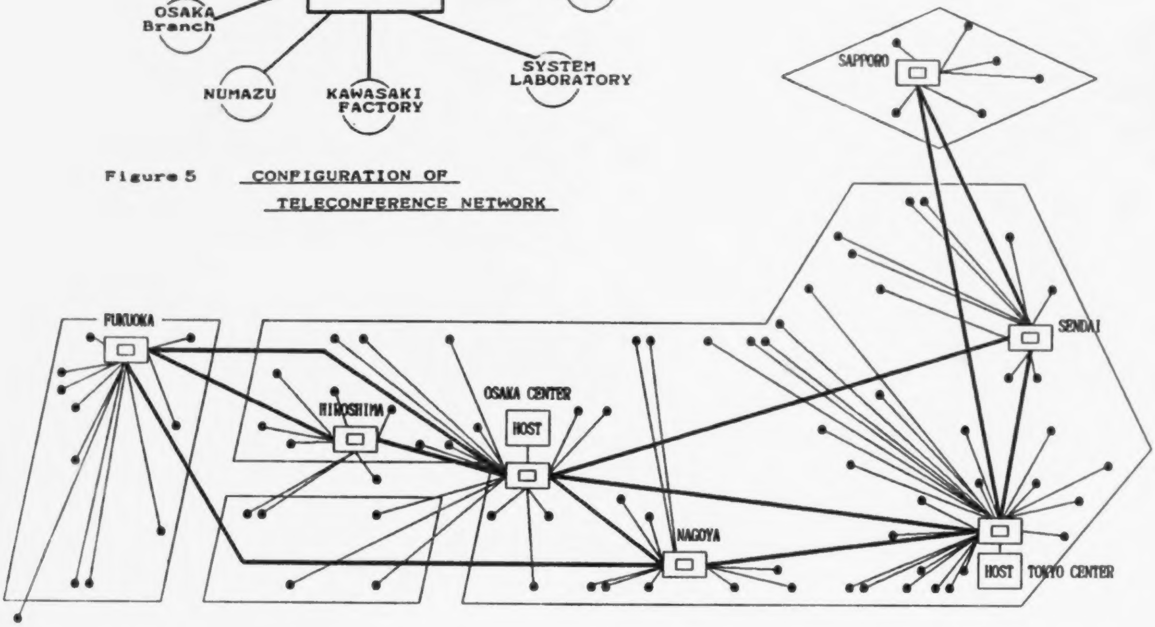

SAPPORO
SENDAI
FUKUOKA
HIROSHIMA
OSAKA CENTER
HOST
NAGOYA
HOST
TOKYO CENTER

Figure 6 CONFIGURATION OF FENICS NETWORK

	Business Application Service	General-Purpose Application Service	Data Base Service	Personal Computer Communication Service
Application Service	• Industry VAN · Food Industry VAN · Apparel Industry VAN · Sports Goods VAN · VARNET • Customized Application · EOS(Electronic Ordering Sytsem) · Storefront Information Collection · POS Data Gathering and Analysis • Inter-Company Data Exchange	• ATLAS(Automatic Translation System) • CAD • AI(Artificial Intelligence) • Software Development Support Service	• Domestic DB Service • Overseas DB Service **OA Service** • Business Word Processor Communication Service • Electronic Chit System • Conference Room Reservation System	• Mail/Bulletin Board Service (BBS) • Information Service • Transaction Exchange • Forum(SIG Service) • CUG(Closed User Group)Service

	Communication Processing Service	
Network Service	• Store and Forward Service -Electronic Mail Service -Facsimile Mail Service -Voice Mail Service	• Network Interconnection Service -International Network Service -Gateway Service
	Basic Communication Service	
	• Dedicated Line Service • Packet Switching Service • Circuit Switching Service	

Figure 7 FENICS Service Menu

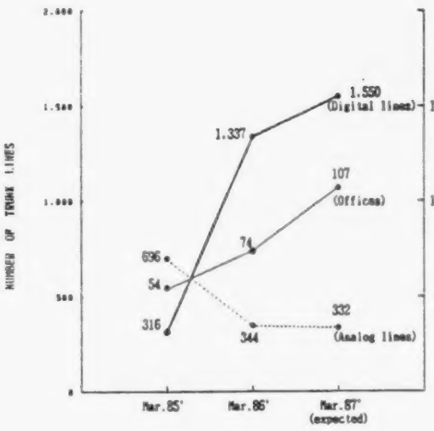


Figure 8 CHANGE IN TRUNK LINES OF TELEPHONE NETWORK

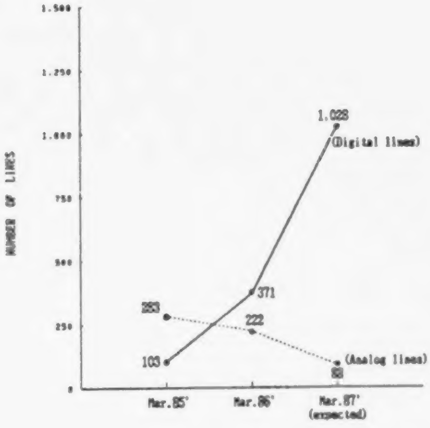
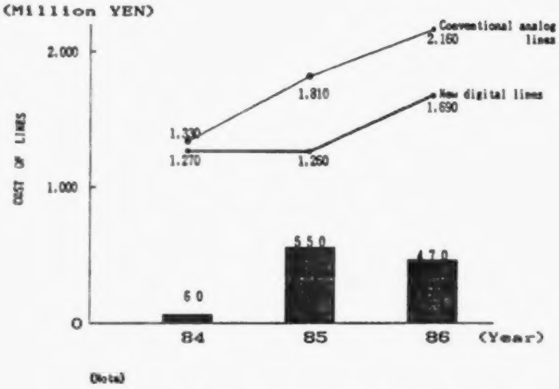


Figure 9 CHANGE IN DATA COMMUNICATION LINES

Table 2 TELECONFERENCE STSTEM USE STATUS

	Tokyo-Osaka	Kawasaki-Oyama	System Laboratory -Numazu
Frequency of use per month	30 time	20 time	15 time
Total number of people using the system per month	100 persons	80 persons	60 persons



(Note)

Bar graphs with slant lines indicate cost benefit yielded by replacing analog lines with digital lines.

Figure10 COST EFFECTIVENESS

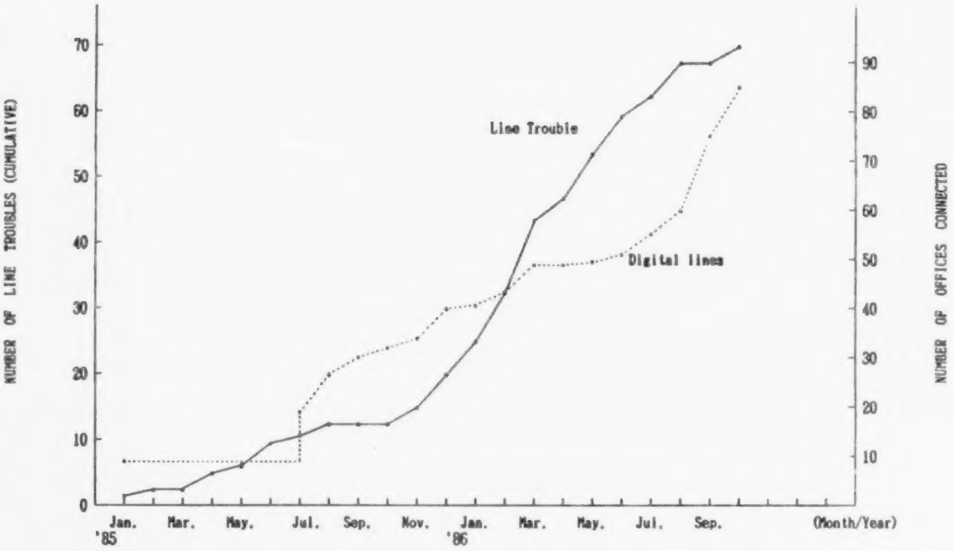


Figure11 CHANGE IN TROUBLE OCCURRENCE OF DIGITAL LINES

Table 3 CAUSES OF LINE FAILURES

Weather (Rain and snow)	Failure of Central Office equipment	Cause unknown	Terminal equipment failure
13 (20%)	23 (35%)	25 (39%)	4 (6%)

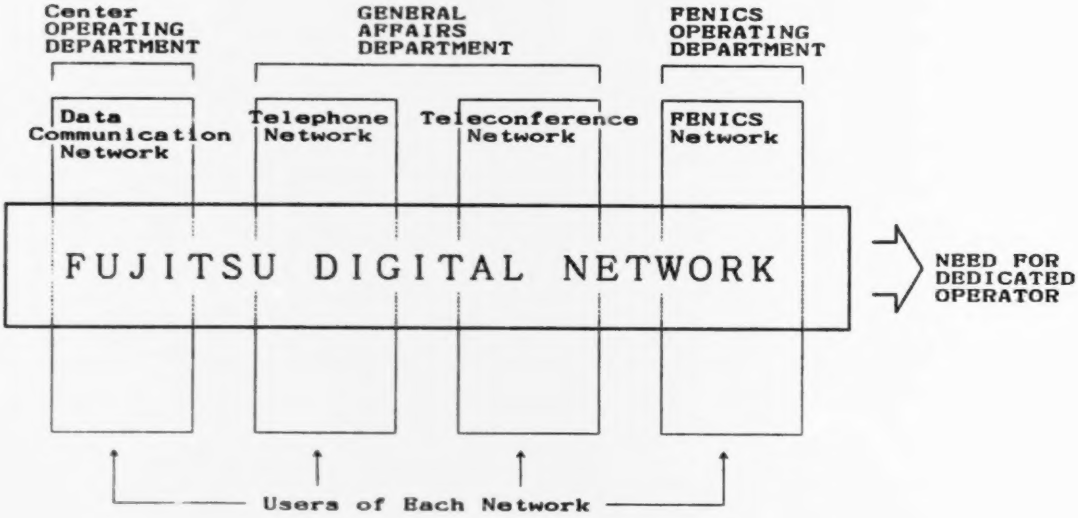

Center OPERATING DEPARTMENT
GENERAL AFFAIRS DEPARTMENT
FENICS OPERATING DEPARTMENT
Data Communication Network
Telephone Network
Teleconference Network
FENICS Network
FUJITSU DIGITAL NETWORK
NEED FOR DEDICATED OPERATOR
Users of Each Network

Figure12 ORGANIZATION OF DIGITAL NETWORK OPERATION

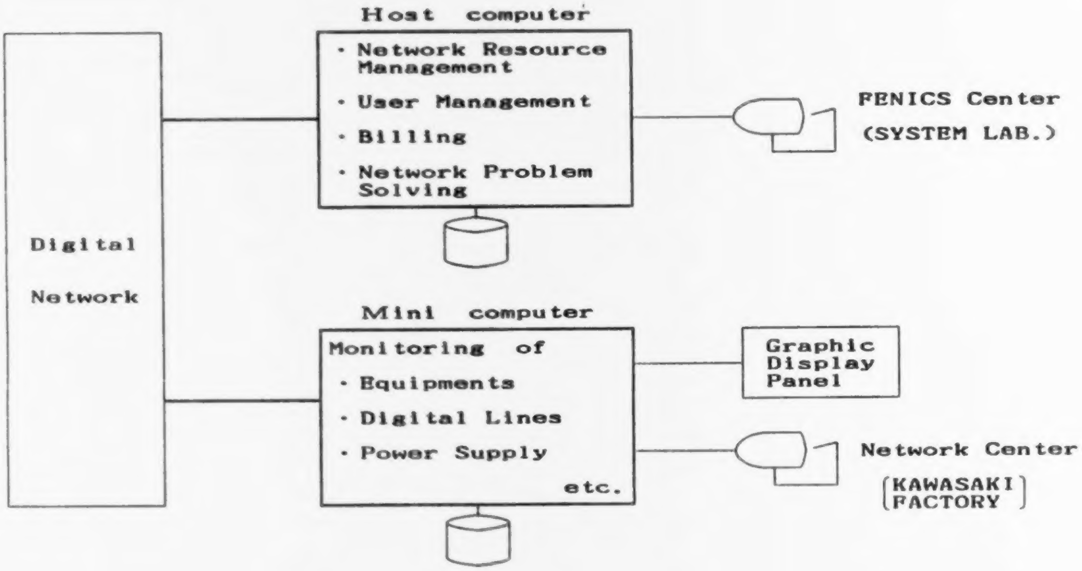

Host computer
· Network Resource Management
· User Management
· Billing
· Network Problem Solving
FENICS Center (SYSTEM LAB.)
Digital Network
Mini computer
Monitoring of
· Equipments
· Digital Lines
· Power Supply
etc.
Graphic Display Panel
Network Center
KAWASAKI FACTORY

Figure13 Network Monitoring and Management System

The Present Status and Future Trend of Private ISDN Using High Speed Digital Path

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Tokyo, Japan

1. Abstract

Along with the rapid increase of information volume in recent years in Japan, efficient processing methods have been studied. Especially in companies, office automation (OA) and factory automation (FA) have been promoted to cope with the trend of widening and spreading locations of company activities. As a result of studying efficient private communication systems, private ISDN using high speed digital path has started to be introduced. This paper covers the present status of private ISDN in Japan, and the multimedia multiplexer as the core of private ISDN, and predicts their trend in the future.

2. INTRODUCTION

The private communication system is an intracompany or intercompany communications system organically combining private branch exchanges, information processors, data terminal equipment, image transmission equipment and data bases by using the leased circuits service for improving the economy and usability of the information communication system.

Conventional private communication systems have developed as dedicated networks such as telephone networks and data networks or as centralized networks centering around the keypoint of activities. In such a background, each company has been studying various problems as follows:

- Efficient methods for processing acceleratingly increasing volume of information and means for the reduction of annually increasing communication expenses
- Improving the communication among widening and spreading locations of company activities
- Promoting the cooperation between companies as the countermeasures for diversifying social structure
- Definite execution plans for modernization including office automation and factory automation

In such a social background, NTT (Nippon Telegraph and Telephone Corporation) started high-speed digital transmission service capable of high-speed transmission of mass information.

3. PRIVATE ISDN

3.1 HIGH-SPEED DIGITAL TRANSMISSION SERVICE

Four major features of high-speed digital transmission service are as follows:

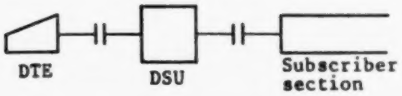
- Mass information can be transferred at high speeds.
- The purpose of use is not restricted and composite use is possible.
- A set of service classes makes it possible to select the optimal bit rate required, resulting in an economical network.
- High-quality transmission is possible.

Realization of high-speed transfer of mass information as the first feature has brought about two big changes in the construction of a private communication system. One is the integration of the telephone and data networks which have been formed separately by using conventional analog leased circuits. Furthermore, facsimile communication rapidly increasing in recent years is planned to be incorporated. Such integration will greatly reduce the communication cost. The other, is the realization of new systems for large-volume file transfer, CAD/CAM, teleconference and other purposes requiring transmission of mass information.

These are naturally due to non-restriction in use and economy as the second and third features. High-quality transmission as the fourth feature has made it possible to develop new services using new media not provided in the past.

Since these features match the needs of the companies aiming at construction of efficient private communication systems, high-speed digital transmission service has rapidly been spreading.

Table 1 shows the speed classes and subscriber line transmission systems currently in service in Japan. DTE in table 1 is the terminal equipment provided by the user. Multiplexers for multiplexing signals from private branch exchanges, information processors, data terminal equipment and image transmission equipment to the transmission lines are generally used. DSU is the digital service unit provided by NTT.



Speed class (Kb/s)	User network interface speed	Subscriber line
64	80 Kb/s	Metallic cable Subscriber radio circuit
192	1,544 Mb/s	Metallic cable Optical fiber cable Subscriber radio circuit
384		Optical fiber cable Subscriber radio circuit
768		Optical fiber cable Subscriber radio circuit
1,536		Optical fiber cable Subscriber radio circuit
6,144	6,312 Mb/s	Optical fiber cable Subscriber radio circuit

Table 1 Service speed classes and subscriber line transmission speed

Three user-network interface speeds are used. One of them (1.544 Mb/s) applies commonly to the speed classes from 192 Kb/s to 1,536 Kb/s. Thus enabling the easy modification of service class even after the network has been constructed.

3.2 CONSTRUCTION OF PRIVATE ISDN

The most important point to be considered in constructing a private ISDN is how to establish the new system while maintaining compatibility with the existing network.

The next point is how and when the new technologies for improving the grade and efficiency of the system should be introduced.

It is, therefore, necessary to start from the following jobs:

- Locations, scales and

- Knowing the equipment used in the existing system
- Grasping the traffic and forecasting the future growth rate
- Constructing the system matching the business purpose

The construction of the new private ISDN considering the existing system is promoted in steps as shown below.

- Trunk network formation
- Branch network expansion

After the completion of countrywide network construction, the grade and efficiency of the system are to be improved.

As shown in Fig. 1, the trunk network construction in the first step connects major points of business with 1.5 Mb/s and 6 Mb/s high-speed digital transmission lines to realize a private ISDN integrating the telephone network (including facsimile network) and the data network.

The branch network expansion in the second step, as shown in Fig. 2, connects medium and minor points of business with high-speed transmission lines in Kb/s classes such as 192 Kb/s, 384 Kb/s and 768 Kb/s.

Conventional leased lines may be used for economy in view of the traffic and information volume.

Such stepped expansions to the countrywide networks are indicated by the data in Fig. 3 which shows the status of orders for high-speed digital transmission service received by NTT. The percentage of annual Mb/s class (1.5 Mb/s and 6 Mb/s) orders received as of July 1980 were more than those as of July 1981, while the Kb/s class (384 Kb/s and 768 Kb/s) orders as of July 1981 were more than those as of July 1980. The quick increase in the orders for 64 Kb/s represents the orders for replacing the conventional DDX (digital data exchange) service with the less costly high-speed transmission service, and is not directly related to private ISDN.

However, 64 Kb/s will be used for small-capacity lines in private ISDN in the near future.

Since private ISDN is one of important strategic factors for companies, networks expanded to countrywide scale will further be improved in grade and efficiency. Since it depends much on future technical development, it will be discussed in section 5.

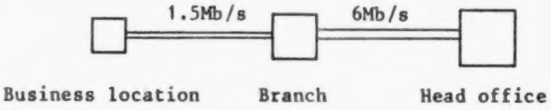


Fig. 1 Trunk network construction

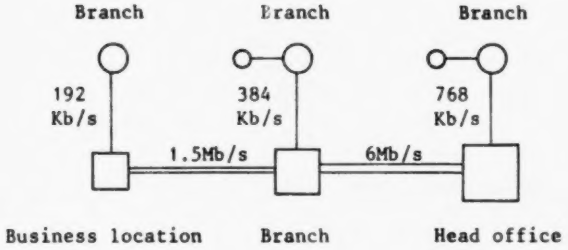


Fig. 2 Expansion to branch network

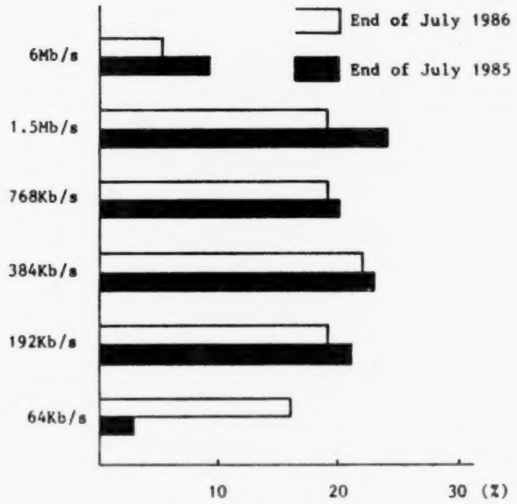


Fig. 3 Status of received orders by speed class

3.3 TYPICAL EXAMPLE

The integration of telephone and data networks with further integration of teleconference, CAD/CAM and other new networks by the construction of private ISDN will require the multimedia multiplexer, for multiplexing and connecting the various media to high-speed digital lines, to be installed at all points of business. The multimedia multiplexer, as the name implies, multiplexes analog and digital, low-to high-speed data efficiently for each point of business and sends the multiplexed signal to each point of business via high-speed digital lines. Fig. 4 shows the connection diagram of various terminals, multimedia multiplexer and high-speed digital lines at one point of business. Telephone (TEL) calls are exchanged by the PBX, and are connected to the multimedia multiplexer for communication with other points of business. For efficient use of high-speed digital transmission lines, voice frequency signals are coded into carries 32 Kb/s using ADPCM (adaptive differential pulse code modulation) technique. Facsimile communication is integrated with the telephone system to establish an efficient network.

Since the data system generally adopts end to end, fixed connections, data terminals and high-speed terminals (teleconference, CAM/CAD, etc.) are directly connected to the Multimedia multiplexer for multiplexing with the telephone system.

As described above, the basic functions of the multimedia multiplexer are high-efficiency coding of voice band signals, optimum channel assignment to each line and efficient multiplexing.

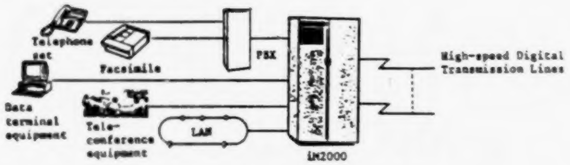

Telephone set
Facsimile
PBX
High-speed Digital Transmission Lines
Data terminal equipment
Tele-conference equipment
LAN
iM2000

Fig. 4 Connection diagram

3.4 REQUIREMENTS

The multimedia multiplexer as the core of private ISDN is required to have the following main features:

Economy

High-efficiency coding of voice band signals and efficient multiplexing with low-to high-speed data shall improve the use efficiency of high-speed digital lines, resulting in reduction of communication expenses.

Flexibility

Digital cross connection capability shall facilitates network configuration/reconfiguration. Various interfaces shall be provided to allow any terminal to be connected.

Useability

Multiports shall be provided to allow bypass and drop/insertion for adaptation to any network configuration.

Serviceability

The network management function shall be provided to facilitate network management. Furthermore, the fault diagnostic function and easy-to-use man-machine interface shall be provided.

Reliability

LSIs shall be used as far as possible for reliability improvement and easy maintenance.

Availability

The system availability shall be improved by adopting duplex configuration.

4. TECHNOLOGICAL IMPACT

4.1 HIGH-EFFICIENCY VOICE CODING

Various coding methods have been studied in various countries as regards the voice coding method.

One example of the coding method being used in the multimedia multiplexer is the 32 Kb/s ADPCM recommended in CCITT G.721. Since this ADPCM is not capable of 9,600 b/s transmission of GIII facsimile, advanced ADPCM capable of this transmission has been developed and used in Japan.

Especially in Japan where facsimile has been spread widely, 9,600 b/s transmission of GIII facsimile is essential.

As regards 16 Kb/s coding, the results or a few methods have been reported, but it is still in the introductory stage for use in the actual network.

4.2 NETWORK CONTROL AND MANAGEMENT

The network control and management consist of the cross connecting function, diagnostic function, monitor function and alarm message collection function.

Cross connecting function

This function enables the user to vary the voice and data channel configuration according to the traffic. For example, it is possible to increase voice channels and decrease data lines in the daytime, and conversely to decrease voice channels and increase data channels in the nighttime. Another example is to switch thd data terminals connected to the network.

In this way, the cross connecting function provides flexibility in network configuration.

Diagnostic function

This function enables the user to carry out remote or local loopback without requring any external measuring instrument. This is a typical diagnostic function helping the user in locating the faulty place when a trouble occurs.

Monitor function

This function enables the user to carry out local or remote monitoring of the data terminal interface signal status and operation status. This function facilitates troubleshooting for data channel, etc.

Alarm message collection function

This function collects and displays the information about the troubles of high-speed digital lines and the multimedia multiplexer.

This function makes quick, easy detection of the faulty place when a hardware trouble occurs.

5. CONFIGURATION

Fig. 5 shows the multimedia multiplexer configuration. In this figure, the voice hand signal is connected to the voice channel (VCH), and multiplexed to 32 Kb/s x N rate by the voice multiplexer (VMX). The data signal is connected to the data channel (DCH) and is multipled to 32 Kb/s x N rate by the data multiplexer (DMX).

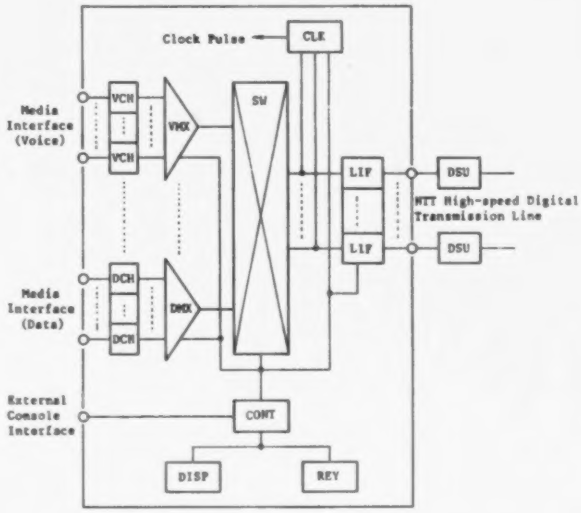


Fig. 5 Multimedia Multiplexer Configuration

These 32 Kb/s x N signals are sent to the cross connector (SW). On the other hand, received signals enter the line interface (LIF) to be processed and sent to the SW. The SW, called the time-division switch, switches the signals from the VMX, DMX and LIF in units of 32 Kb/s and sends them to the VMX, DMX and LIF. This switching operation is controlled by the control data from the controller (CONT).

The control data is either input from the keyboard (KEY) or received from the console installed at a remote location.

Table 2 shows the major specifications of multimedia multiplexer iM2000 designed according to the concept so far described.

High-speed Digital Line Interface	Conforms to NTT's High-speed Digital Line Specification
Transmission Rate	64K, 192K, 384K, 768K, 1.536M, 6.144Mb/s
Data Interface	
Asynchronous	300, 1200b/s (CCITT V.24/28, X.20/V.10)
Synchronous	2.4, 4.8, 9.6Kb/s (CCITT V.24/28, X21/V.11) 48Kb/s (CCITT V.35, X.21/V.11) 64, 64 × N Kb/s (RS-449 others)
Voice Signal Interface	
Analog Interface	
Signaling	SS/SR
Coding Rate	64Kb/s, 32Kb/s (compatible with GIII FAX), 16Kb/s
Physical Interface	2W/4W
Digital Interface	64K, 2.048Mb/s
Alarm Feature	Line SYNC Alarm and SEND Alarm, etc.
Diagnostic Feature	Various Loopbacks, etc.

Table 2 iM2000 Major Specifications

6. FUTURE TREND

6.1 MARKET TREND

The construction and expansion of private ISDN are not merely streamlining and labor saving in a company. It is a management strategy of a company today.

The introduction of private ISDN will realize organic linkage beyond a business group. Along with the change in the social structure, systematic cooperation of manufacturing, distributing, sales, service and financing companies is promoted to give rise to information communication systems matching the social structure. For example, integrating the networks of the manufacturing and distribution industries to construct a common data base will realize a system for systematic order issuing and receiving and for quick grasp of the market trend.

6.2 TECHNICAL TREND

Multimedia multiplexers have so far been developed by individual manufacturers. As a result, private ISDN constructions have been promoted rapidly. Spreading ISDNs, however, have revealed the problem in interconnecting multimedia multiplexers of different manufacturer. Interface standardization has become an urgent task. The frame format for multiplexing by the multimedia multiplexer, high-efficiency voice coding method, and network control and management methods have to be standardized. In Japan, TTC (The Telecommunication Technology Committee) mainly consisting of private companies is now planning to standardize the multiplexing frame format as the first step. Other interfaces will be standardized in the future.

With regard to the high-speed digital transmission service, various new services will be implemented. Such new services will probably include the improved drop/insert service, multiple access service providing multiple lines for one subscriber line, exclusive time service providing the service for a given time, and asymmetric line service in which the information flow is asymmetric. Finally network utilization technologies for upgrading the private ISDN making use of various high-speed digital transmission services, public communication network, multimedia multiplexers and various terminals to enable the ideal network desired by users to be formed.

7. CONCLUSION

The social structure in the world has been changing incessantly. Along with the change, the private communication system has been complicated. Constructing the private ISDN to cope with the complicated system is a duty of communication equipment manufacturers including Oki Electric Industry Co., Ltd. We believe that the private ISDN applicable to any private communication system will form the infrastructure of the management strategy of a modern company.

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Design and Engineering Guidelines
for
Effective Network Planning

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1. Abstract

This paper describes some of the technological advances which have altered the way in which modern networks are planned and implemented, and discusses guidelines and planning tools which will enable telephone Administrations to make most effective use of these technologies in modernizing their networks. Network services that are made possible by today's advanced network capabilities and are highly demanded by business customers are also discussed. By planning for these services in the network modernization process, an Administration will be well prepared to meet the challenges of the increasingly competitive marketplace.

2. NETWORK PLANNING GUIDELINES

2.1 Network Performance Considerations

Network performance objectives are normally included in the national network standards for an Administration. Figure 1 lists some of the key criteria or measures that comprise the performance objectives for a telecommunications network. While all of these performance considerations are important, this paper will focus on switch and inter-exchange circuit blocking to illustrate the key points being made in the paper regarding network performance.*

Switch blocking is the probability of a call blocked at a network node or switch because of traffic congestion at the switch. Such blocking occurs most frequently in local switches because of the concentration between subscriber lines and switching network paths that is engineered for cost saving or economic reasons. Modern digital local exchanges typically use either time division or space division means to effect this concentration from lines to internal switching network paths. Naturally, if the concentration ratio between lines and internal switching network paths is high, the cost of the switch on a per line basis will be lower, but if the traffic per line is high, the switch blocking will be high. On the other hand, if the concentration ratio between lines and the internal switching network paths is low, the cost of the switch will be higher and even if the traffic per line is high, the switch blocking may be low. Hence, the Administration planners need to weigh a number of factors when engineering a new local exchange. They need to understand their per line traffic, the cost of the switch as a function of concentration ratio, and the level of switch blocking that is considered acceptable.

NETWORK PERFORMANCE CONSIDERATIONS

- **Network performance objectives**
  - **- Switch blocking**
  - **- Inter-exchange circuit blocking**
  - **- Dial tone delay**
  - **- Call set-up delay**
  - **- Transmission quality**
- **Network performance balance**

FIGURE 1

Inter-exchange circuit blocking is the probability that a call is blocked due to the lack of a sufficient number of inter-exchange circuits between two network nodes. The number of circuits provided are determined by the amount of traffic to be carried during the busy-hour for the circuit group and the level of inter-exchange circuit blocking considered acceptable. Naturally, for a specified level of busy-hour traffic, the level of blocking can be made as low as desired by simply providing a sufficient quantity of inter-exchange circuits. However, this improvement in performance does not come for free and has an associated cost which is a function of the circuit group type and inter-exchange distance.

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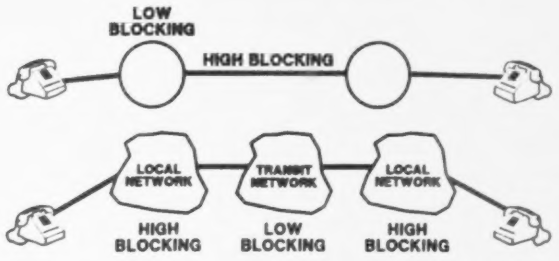
* Network performance considerations recommended in this paper are appropriate for Administrations that are responsible for overall network performance. If, in a particular country, the local and transit networks are administered by different Administrations, then the overall performance objectives should be coordinated among the Administrations to achieve an optimal balance among all of them.

For a mature network, an Administration will specify a desired level of switch and inter-exchange circuit blocking to guide network engineering. In many cases it may be desirable to engineer network additions to these desired "objective" levels of blocking. However, in developing countries where the networks are growing and far from mature, there may be instances where construction funds are scarce and the probability of blocking elsewhere in the network is high. In such cases, the Administration may choose to engineer the addition to the network to a higher level of blocking than the desired objective. To do otherwise would require the expenditure of more construction funds initially with less effective overall improvement in network performance from the customer perspective. As long as a growth addition can be planned at a future date to bring the switch and inter-exchange circuit blocking into compliance with the desired "objective" levels on a balanced basis with the remainder of the network, more construction funds can be spent initially giving new customers access to the network. Figure 2 illustrates the importance of keeping network performance in balance.

KEY CONSIDERATIONS FOR SETTING PERFORMANCE OBJECTIVES

• NETWORK PERFORMANCE BALANCE



RESULT: END-TO-END HIGH BLOCKING

FIGURE 2

In addition to allowing more construction funds to be used to add new customers to the network, there are two other reasons for the Administration to temporarily accept a higher than desired level of switch and inter-exchange circuit blocking in a developing network. These are:

1. The customer call attempt rate may drop as the telephone density increases and there is less sharing of telephone lines. Since lines will be less busy, this will impact both originations and completions.

2. The customer call attempt rate may drop as the performance of the network (in particular the call completion rate), improves in general through better engineering, provisioning and maintenance.

In summary, when developing and modernizing a network, an Administration need not require long term performance objectives to be met immediately. In fact, more construction funds will be available to add customers to the network if a phased approach is followed. This is especially true when one considers the impact on customer traffic of increased telephone density and gradual improvement in network performance. The key considerations for setting network performance objectives are summarized in Figure 3.

KEY CONSIDERATIONS FOR SETTING PERFORMANCE OBJECTIVES

- **Evolution from near term to long term**
  - **Set appropriate near term objectives based on current conditions**
  - **Define realistic long term goals**
  - **Improve performance gradually as network evolves**
  - **Coordinate improvements across disciplines**
  - **Always seek optimal trade-off and balance**

FIGURE 3

2.2 Network Planning

Upon establishing the appropriate objectives for their network, an Administration needs to identify the most comprehensive plan for developing an efficient network to meet the objectives. In doing this the Administration must analyze a wide range of technical and economic issues and quantify the impacts of multiple interactions among them. Many potential tradeoffs must be evaluated for different network modernization alternatives. For example, initial capital costs must be considered in conjunction with recurring operations, administration and maintenance (OA&M) costs over the projected life of the alternative and converted to a present worth of expenditures figure (PWE) to correctly compare alternatives. By so doing, the cost of money and the impact of inflation are also considered. This then allows a comprehensive life cycle cost comparison of alternatives to be made. This is important, because if the Administration considers only initial capital costs, they could implement an alternative with low initial capital costs but high recurring OA&M costs leading to high life cycle costs.

Another factor that is important to consider when evaluating alternatives is the incremental revenue generating capability of new features made possible by each alternative. This can be treated as a negative expense by the Administration and evaluated over the life cycle of the alternative in the same way as expenses.

The software planning tools discussed later in this paper are essential to the efficient analysis required to effectively carry out life cycle oriented network planning studies.

Other key tradeoffs that are important for an Administration to consider when planning their network are:

1. Subscriber loop versus switching versus transmission tradeoffs. Here the tradeoff analysis simply requires understanding the economic impact on the network of the new switching and transmission technology, e.g., PCM, subscriber multiplex systems and fiber in the transmission area, and distributed architecture, remote switching and large capacity in the SPC digital switching area. The tools discussed later are also essential to this analysis. More will be said about this later.

2. Centralized OA&M versus non-centralized OA&M is another important tradeoff for an Administration to consider when planning their network. This has been referred to as operations planning. Any time an Administration is planning a significant expansion or modernization of their network, they must determine how and to what extent they need to modify their network operations plan. New job descriptions need to be created, old job descriptions need to be modified and training needs to be carried out if the network modernization is to progress smoothly and effectively. Advances in technology and network capability are changing many aspects of the network operations function requiring greater centralization of operations supported by computers. This trend can be expected to continue as we move to ISDN and beyond, hence Administration planning must take it into consideration.

2.3 The Benefits of Alternate Routing

Alternate routing has been used with common control electromechanical switching systems, but it is being more widely used to realize network economies now that SPC switching technology is achieving broad acceptance.

Planning techniques and tools are available to analyze the point-to-point traffic requirements of a network, in conjunction with a preliminary network hierarchy and routing plan, to engineer appropriate high-usage inter-exchange circuit groups with high overflow (and hence high efficiency/economy, see Figure 4). Since traffic offered to these efficient high-usage routes can overflow to alternate routes that are more liberally engineered and generally larger in size, the customer experiences a network performance reflecting low blocking and the Administration sees the benefits of a network that is efficient in terms of the number of inter-exchange circuits.

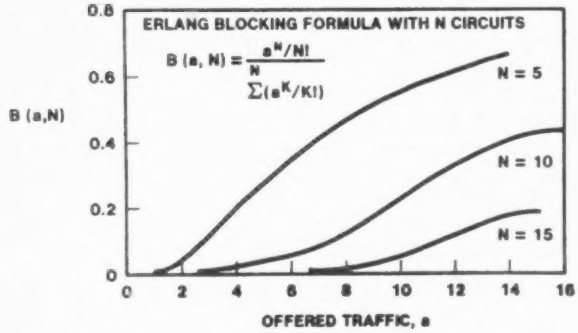


FIGURE 4 : HIGH EFFICIENCY OF ALTERNATE ROUTING

2.4 The Benefits of Large SPC Switches

As mentioned previously, one of the tradeoffs to be considered by network planners is the tradeoff between switching and subscriber loop and inter-exchange transmission circuit costs. In the case of the local network, larger switching exchanges lead to fewer switching nodes and a reduction in switching related life cycle costs. This is achieved, however, with some increases in the subscriber loop costs. The impact of this increase is diminished significantly, however, due to the distributed architecture (remote switching capability) of some of the SPC local digital switching systems on the market today. Figure 5 illustrates the distributed architecture of one of these systems, the AT&T 5ESS switching system.

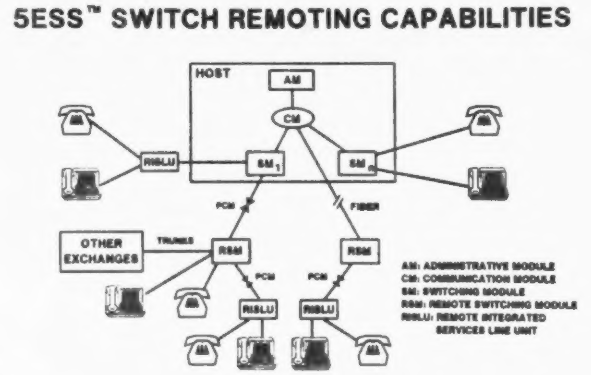

5ESS™ SWITCH REMOTING CAPABILITIES
HOST
AM
CM
RISLU
SM_1
SM_n
PCM
FIBER
OTHER EXCHANGES
TRUNKS
RSM
RSM
PCM
PCM
RISLU
RISLU
AM: ADMINISTRATIVE MODULE
CM: COMMUNICATION MODULE
SM: SWITCHING MODULE
RSM: REMOTE SWITCHING MODULE
RISLU: REMOTE INTEGRATED SERVICES LINE UNIT

FIGURE 5

In the case of the transit and tandem networks, larger switching exchanges lead again to fewer switching nodes and a reduction in switching related life cycle costs. While fewer switching nodes will require on average longer inter-exchange circuit groups, there will be a net savings in inter-exchange circuit costs if the proper tradeoff point is selected by the network planner. This point will depend upon a number of factors unique to the network being planned, e.g., geographic locations of customer concentrations or wire centers and distances between them, etc. Figure 6 illustrates how the total network costs (Net Present Worth of Expenditures) were found to vary as a function of the number of nodes in a selected region of a national transit network. Planning tools among those to be discussed later were used to generate the data summarized in Figure 6.

The key point being made in this section is that selected modern SPC digital exchanges offer the network planner increased switching system call processing capacity and distributed switching system architecture (reliable remote switching capability) which can be used by the network

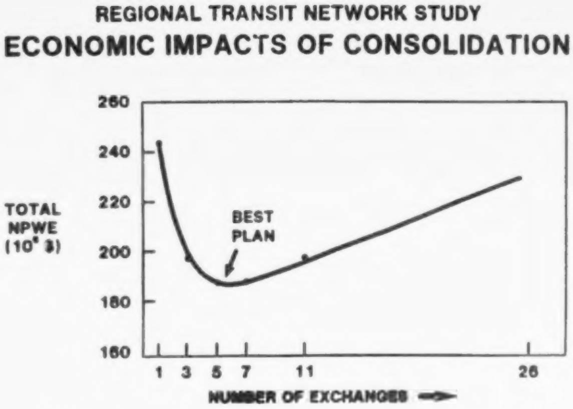


FIGURE 6 : NPWE AS A FUNCTION OF NUMBER OF EXCHANGES

planner to design a more efficient and cost effective network. In other words, these advances in switching technology, coupled with the improvements in planning methodology and tools, have significantly improved the options available to and the overall effectiveness of the network planner.

2.5 Using Modern SPC Technology to Achieve Improved Network Maintenance

In addition to changing the way networks are planned and implemented, modern SPC technology also significantly improves network maintenance capabilities, thereby providing even greater network efficiency and economy. As an example, modern SPC exchanges like the 5ESS switch have an inherent capability to monitor call failure problems and correct them to increase call completion. The monitor system not only detects explicit faults such as hardware or software errors, but also subtle faults that are only detectable by statistical analysis of data over time. By isolating and analyzing these faults, service impairing problems, both internal and external to the exchange, can be quickly identified and solved to improve the performance of the switch as well as the connecting network. Since this call failure analysis capability is built in to the switch, no additional operation and maintenance capital cost is required.

In the early days of telephone service where operators connected all calls, they detected all network irregularities and served as the "eyes of the network". This function was lost when the operators were replaced by electromechanical exchanges because many irregularities could not be detected by these exchanges. The advanced call failure analysis features of selected SPC exchanges reopen the eyes of the network and have a major effect on network operation and maintenance. As more SPC exchanges with these features are introduced into the network, an Administration needs to evaluate their operation and maintenance procedures to ensure that they are taking full advantage of the improved maintenance capabilities offered by such systems.

Based upon the switching equipment and the signaling protocols used, there exists two general techniques of call failure analysis: machine detectable irregularity analysis and statistically detectable irregularity analysis. Machine detectable irregularities refer to call failures detected during call processing. They generally indicate hardware faults in electronic circuits or the switching network, or software errors in the exchange database. Usually, one error is not sufficient to detect the exact cause of a problem. Thus, irregularities are logged in the exchange as they occur, and analysis is performed later to provide specific information about any inter-exchange call problems, either hardware or software.

Statistically detectable irregularity analysis relies on statistical methods for call failure identification. It discovers subtle call failure reasons not detectable as a specific machine detectable irregularity. One example is to locate circuits with consistently short holding time, which may indicate main distribution frame interconnection faults or poor transmission quality. Another example is the analysis of unanswered calls to uncover failures due to non-obvious reasons such as vacant code, misrouting of a digit, or insufficient digits to outpulse. Once the actual failure reasons are identified, the problems can be corrected and the call completion rates will improve.

SPC exchanges with advanced maintenance features such as call failure analysis allow an Administration to achieve and maintain a high-level network performance with minimum effort. These features therefore should play an important role in the specification and selection of new SPC exchanges.

2.6 Network Services Planning

Since the late 1970's, signaling in the telephone network (i.e., the exchange of control information between exchanges) has seen a dramatic shift from conventional analog in-band signaling to the use of a common channel signaling (CCS) network. The first nationwide CCS network was introduced in the United States by AT&T Communications (AT&T-C) in 1976. Initially, the CCS network was used primarily for transporting control signals for plain old telephone service (POTS) to reduce call set-up time and thereby increase inter-exchange circuit efficiency. However, very soon it was recognized that the power of CCS vastly expands the capability and flexibility of an SPC network to allow a wide range of new and innovative network services to be provided.

Experience in the United States and other countries indicates that these network services are in great demand among business customers, large or small. In fact, in some countries where these services are not yet available, telephone Administrations are being hard pressed to offer them. This phenomenon is critical since Administrations in many countries are facing increasing challenges in the marketplace. If business customers' vital telecommunications needs cannot be satisfied by one particular Administration, very soon they will seek other alternatives, either by accessing another network which provides these services, or by developing their own facilities/networks. In either case this would imply major revenue loss to the Administration. On the other hand, if network services are offered in a timely manner, not only is the business community's dependency on the public network strengthened, the economy and convenience of the services offered often stimulate a much higher usage of the public network, resulting in even greater revenues for the Administration. In fact, in the long term, the cost of developing network services is insignificant compared with the profits generated. By planning for the new services when modernizing the existing network, an Administration will be well prepared to meet the challenges of today's highly competitive marketplace. To be effective, the planning of network services and the growth of CCS should be an integral part of the overall network modernization plan.

In planning for network services, it is important to note that 1) there are a lot of similarities in the capabilities needed for many services, and 2) detailed information about customer requirements is often insufficient at the time development work begins. For these reasons, it is important to plan for a network capability which is robust enough to accommodate variations as customers define their own customized requirements to meet their specific needs. AT&T-C achieves this goal by developing a set of capabilities called Direct Services Dialing Capabilities (DSDC) in the SPC network. Calls requesting DSDC service are identified by special prefix of the dialed digits (e.g., 800). The principles of DSDC are: a) the placement of service independent network capabilities throughout the network which can be used by any DSDC call, b) the concentration in a few databases (strategically located in the CCS network) sophisticated call-handling logic which determines the handling of all DSDC calls, c) the ability of a DSDC customer to change the call handling logic pertaining to his/her service by providing instructions to the databases, and d) universal access to the DSDC capabilities from anywhere in the country. The sophisticated databases in the CCS network are referred to as Network Control Points (NCP). The service independent network capabilities are contained in SPC exchanges which have a set of special software to give them the ability to interact with NCPs via the CCS network to request specific customer call setup information. Exchanges with these capabilities are referred to as Action Points (ACP). Thus, one can say that the NCP contains the logic that defines how the network capabilities in the ACP are to be combined to form a network service.

Figure 7 shows the DSDC generic architecture. A DSDC call is first routed to an ACP, which will send an inquiry containing the dialed number and some information about the call originator (e.g., originating area code) to an NCP via the CCS network. The NCP checks the customer record pertaining to this call, identifies the action to be taken as specified by the customer, and returns a command to the ACP. The command will activate the capabilities contained in the ACP to take the requested action, e.g., to collect more digits from the caller, to play an announcement to the caller, to route the call to a customer-specified number in the public network, or to terminate the call. DSDC customers can easily define their service characteristics, change the way their service functions and monitor their service operations.

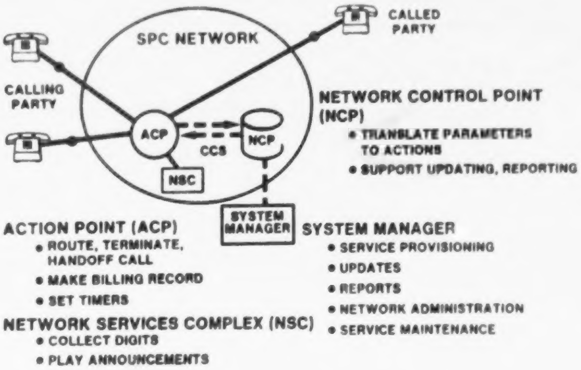


FIGURE 7 : DSDC GENERIC ARCHITECTURE

Using the flexibility of DSDC, AT&T-C today offers a number of highly sophisticated network services that are very popular among business customers. Two examples are briefly described here to illustrate the DSDC concept.

2.6.1 AT&T 800 Service

AT&T 800 Service provides national advanced toll-free calling, which is an extremely attractive service to all business segments in the U. S. Using the AT&T 800 Service, calls are paid for by the called customer and are free to the calling party. All toll-free numbers are identified by the special prefix 800. With DSDC, a customer with multiple locations can advertize a single toll-free number that can be dialed from anywhere in the United States, and can specify to which particular destination a toll-free call should be routed based on parameters such as the caller's area code, time of day, and day of week. For instance, Figures 8 to 10 show that a customer with two locations 803-567-7000 and 503-888-6000 advertizes a single toll-free number 800-583-1000. The customer further specifies that calls from numbering plan area (NPA) 717 should, at all times, be routed to the location 803-567-7000. Calls from NPA 602 during business hours should be routed to 503-888-6000 and to 803-567-7000 after business hours. All these routing instructions are contained in a customer record stored in the NCP. When an ACP sends an inquiry for the toll-free number 800-583-1000 to the NCP, the NCP will verify the originating NPA, time of day, and return to the ACP a message containing the appropriate destination as specified in the customer record. If the customer desires, he/she can change the routing instructions to include considerably more sophistication in this service. For instance, the customer can specify a sequence of alternate destinations to which calls are routed if the primary destination is busy, specify the percentage of calls to be distributed between

two or more destinations, request the caller to enter more digits to direct routing or to screen calls for security reasons, or provide an announcement unique to the customer.

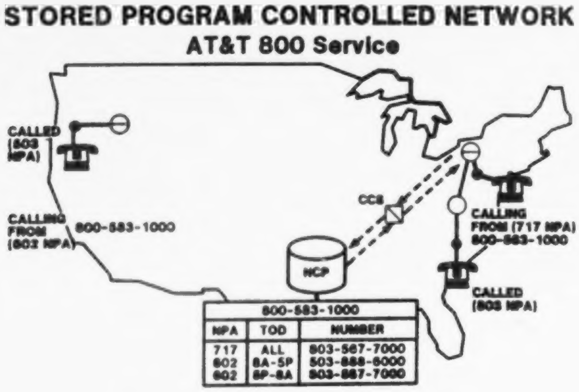

STORED PROGRAM CONTROLLED NETWORK
AT&T 800 Service
CALLED (503 NPA)
CALLING FROM (602 NPA)
800-583-1000
CCS
NCP
CALLING FROM (717 NPA) 800-583-1000
CALLED (803 NPA)
800-583-1000
NPA
TOD
NUMBER
717 ALL 803-567-7000
602 8A-5P 503-888-6000
602 5P-8A 803-567-7000

FIGURE 8 : CALLING FROM 717 NPA

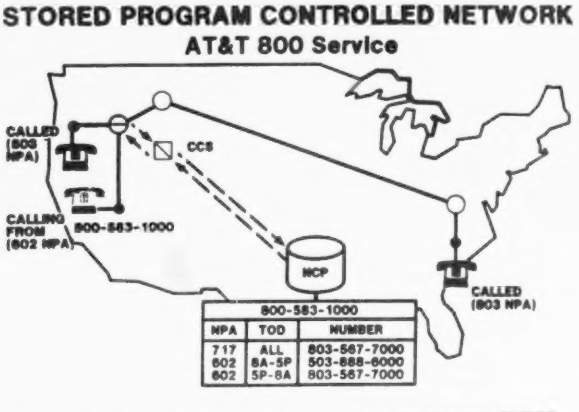

STORED PROGRAM CONTROLLED NETWORK
AT&T 800 Service
CALLED (503 NPA)
CCS
CALLING FROM (602 NPA)
800-583-1000
NCP
CALLED (803 NPA)
800-583-1000
NPA
TOD
NUMBER
717 ALL 803-567-7000
602 8A-5P 503-888-6000
602 5P-8A 803-567-7000

FIGURE 9 : CALLING FROM 602 NPA DURING BUSINESS HOURS

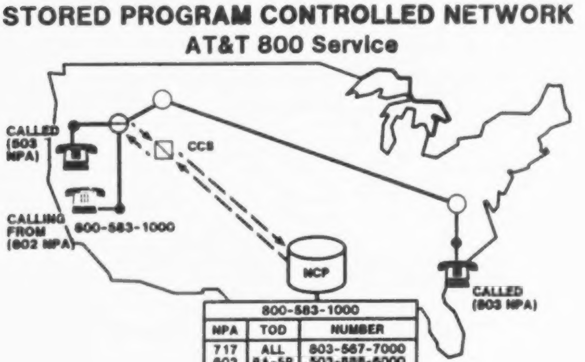

STORED PROGRAM CONTROLLED NETWORK
AT&T 800 Service
CALLED (503 NPA)
CCS
CALLING FROM (602 NPA)
800-583-1000
NCP
CALLED (803 NPA)
800-583-1000
NPA
TOD
NUMBER
717 ALL 803-567-7000
602 8A-5P 503-888-6000
602 5P-8A 803-567-7000

FIGURE 10 : CALLING FROM 602 NPA OUTSIDE BUSINESS HOURS

All of these features are useful by themselves but their real strength becomes more apparent when these features are combined. The DSDC is truly an open-ended capability. Its flexibility allows the customers to interact with the SPC network directly to affect the parameters in the NCP so that their calls will be disposed of in a manner which most efficiently meets their business needs.

2.6.2 Virtual Private Network (VPN) Capability

Many large business/government customers today have their own physically separate private networks, each with dedicated switching/transmission equipment. These private networks are expensive because each network is dedicated to a single customer. Traffic in one congested network cannot utilize resources in other networks even though they may have ample idle capacity. Therefore, to maintain a satisfactory grade of service, the equipment and OA&M cost of a private network may be quite significant.

Using the DSDC, an Administration can provide a set of new capabilities within the public network which allows emulation of private networks and offers new feature and service alternatives to private network offerings. These capabilities are referred to as VPNs. VPN capability offers premises to premises voice and data networking with a wide range of customer selectable feature options, and includes a ppwerful set of customer control, accounting, and surveillance capabilities.

A VPN customer does not own or lease any equipment in the public network. Instead he/she reserves a fixed amount of network resource for his/her use. A call from one VPN location to another will first be routed to an originating ACP either directly or via a local exchange. The call will be recognized as a VPN call by its arrival over dedicated facilities. As in advanced toll-free calling, the ACP will send an inquiry to an NCP, which will in turn determine the disposition of the call based on the customer record. One example is determining if the originating location has permission to place the call to the destination requested. The NCP will also determine if the resources reserved for this VPN customer are still available to serve this call. This capability limits the number of simultaneous VPN calls and provides a means for the customer to control communication costs.

After checking the call handling instructions, the NCP will return a command to the ACP regarding the treatment of the call. If the call is to be routed to its destination, it will be routed across the public network to a terminating ACP. From here the call will either be completed over dedicated facilities to the terminating VPN location, or be routed to a local exchange which will in turn complete the call using VPN dedicated facilities. A call originated from a VPN location can also be routed to a destination in the public network or another private network, determined solely by the call handling instructions in the NCP. Figure 11 shows a typical VPN architecture.

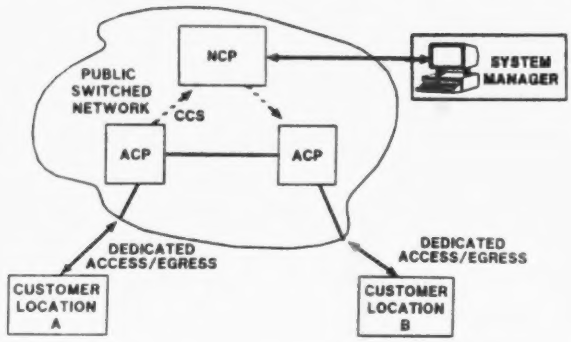


FIGURE 11 : VIRTUAL PRIVATE NETWORK ARCHITECTURE

Major advantages of VPNs as described above are 1) equipment is shared with public network users, 2) small customer groups who cannot afford private networks can be served economically, 3) OA&M functions are integrated with those of the public network, and 4) advanced capabilities are readily available as the public network evolves. In addition, customers can tailor their networks to meet their specific communication needs quickly and easily, and to monitor their service performance effectively.

The keynote paper of this conference "Use of Virtual Private Networks to Satisfy Large Users Needs" by Mr. M. Iwama of AT&T Bell Laboratories contains more in-depth discussions of VPNs.

2.6.3 Overlay Network Approach

To enjoy the benefits of network services as early as possible, it is recommended that an Administration need not wait until their network is completely modernized. An overlay approach can be used to allow early offering of network services. That is, an Administration can overlay the existing network with a digital network equipped with DSDC-type capabilities and offer nationwide network services. Customers can access the overlay network either by direct trunking to the ACPs or by switched access through the existing network. The cost of developing such an overlay network can be easily recovered in a short period of time by the new revenues generated.

A digital network with DSDC integrated or overlay capability can be considered as a pre-ISDN network. Its flexibility and sophistication allows a smooth evolution towards a full ISDN. With such a network in place, an Administration can assure that the data and voice communication needs of its major customers can be economically satisfied, today and tomorrow.

2.7 Software Planning Tools

As indicated earlier, the task of planning a network which rapidly evolves towards digitalization and ISDN is becoming increasingly challenging. The interactions among various disciplines (switching, inter-exchange circuits, transmission, etc) are very complex and forecasts of the future with any high degree of certainty are difficult. A large number of alternatives must be examined to determine an architecture which is both economical for today's requirements and easily adaptable to meet future requirements as they materialize. Furthermore, environmental parameters to which the alternatives are sensitive must be fully studied in the process. This often involves solving a set of highly complicated optimization problems that can only be handled by software planning tools. Such tools make it possible to quantify many complex technical and economic interactions more quickly and accurately than manual methods. They can also incorporate present-worthing techniques to compare capital costs, OA&M expenses, and revenue implications over the entire life cycle of network equipment on a consistent and meaningful basis. These life cycle cost analysis techniques are critical in modern network planning because long term savings resulting from SPC exchange's lower OA&M costs **play an important role in the evaluation of modernization alternatives.** These savings generally outweigh the capital (first) costs of the exchanges and must be considered in the planning process.

Many sophisticated software planning tools have been developed at AT&T Bell Laboratories and successfully used worldwide. A few examples are presented here to illustrate their capabilities and applications.

2.7.1 Planning Tool Examples

Switching Network Evolution Planning (SNEP)

The SNEP program models the possible evolutionary paths for modernizing a local network, and selects the combination of paths that best satisfies the network needs. The modernization vehicle is assumed to be SPC exchanges with host/remote capability. The selection is made based on such factors as capital and equipment constraints and the net present worth of expenditures.

For the exchanges being studied, input data for SNEP includes cost of money; equipment price structure over the study period for various switching systems in use currently, or expected to be in use in the future; their capacities and OA&M costs; network growth forecasts; and any additional or incremental revenues generated by new services like Centrex or ISDN. The next step is to identify reasonable modernization and growth alternatives for each exchange in the study area. An alternative prescribes the technology to be added to the exchange, its timing, and what is to be done with the existing equipment. SNEP allows the user to study as many different alternatives as desired. The program then evaluates each alternative for each exchange over the study period, considering present-worthing of all capital costs, OA&M costs, and new service revenues. The result is the NPWE of that alternative.

After the evaluation, SNEP allows the user to specify any (year-by-year) capital and equipment availability constraints, any network objectives to be imposed as constraints, and reuse value for any replaced equipment. The program then finds the least NPWE solution that meets all these constraints as well as any host remote constraints. In addition, it finds solutions corresponding to various resource and objective constraint levels that are modified from the original constraints. This helps the user to determine the appropriate constraint level if one is not sure what it should be, and the corresponding optimum alternative for each exchange.

Trunk Requirements for the Interexchange Model (TRIM)

Traffic distribution and inter-exchange circuit network design of a large network containing hundreds of exchanges is a difficult task. TRIM is a program that has been developed to facilitate this task. The program is designed to calculate the number of circuits required for the high usage (direct and intermediate) and final circuit groups of a transit and/or local network. It has the capability to distribute traffic between exchanges by taking into consideration the community of interest factors and the exchange sizes. The input data includes the total number of exchanges, network architecture, and information about each exchange such as name, type, location, number of lines, traffic per line, community of interest, and outgoing traffic distribution.

For every year within the planning period, the program first distributes the projected traffic between the exchanges based on community of interest and exchange sizes. The user has the choice to edit this distribution. The final output of TRIM consists of: 1) the point-to-point traffic, one-way high-usage circuit group sizes, and overflow traffic for every pair of exchanges; 2) the one-way final circuit group sizes and the traffic they carry; 3) similar data based on two-way traffic; and 4) incoming and outgoing circuits for each exchange in the local or transit network.

Optimization of Wire Center Locations Program (OWL)

In a network modernization study, two alternatives, i.e., introducing new exchanges to the existing network or consolidating existing exchanges to simplify the network, are always examined. A major challenge of this process is to identify 1) the most economical locations for the new exchanges and 2) the exchanges to be consolidated so that costs are minimized. OWL is a program designed to solve this laborious and time consuming problem. Input data required by OWL includes:

- existing and estimated quantities of subscriber lines and their locations for each study year,
- number of existing exchanges, their locations and characteristics,
- Costs of subscriber lines as a function of distance, taking into account geographical constraints of the study area and the embedded outside plant.

The algorithms used by OWL are heuristic in nature. The program first finds a feasible solution to the problem and then improves it iteratively. Therefore, the program may not generate exact optimum solutions, but always provides near optimum ones. Nevertheless, these near optimum solutions are good enough for selecting the most economic wire center locations.

In addition to these, AT&T Bell Laboratories has also developed tools for other important applications such as transit network modernization planning, inter-exchange transmission facility planning, non-urban long route relief planning, and budget constrained alternatives selection. In conclusion, one can say that modern network planning utilizes a coordinated (area planning) approach that requires active interaction among multiple disciplines. This task cannot be effectively accomplished without planning tools. The use of these tools has many benefits over manual methods. In addition to providing faster results with fewer errors, the tools allow network planners to study a very large number of alternatives and dedicate more of their time to the analysis of study results. Software planning tools will become even more indispensable as a network evolves towards ISDN.

3. SUMMARY

This paper describes some of the capabilities of current telecommunication technology, and discusses network design and engineering guidelines and software planning tools which will enable telephone Administrations to achieve the maximum efficiencies and economies possible with todays advanced capabilities. These efficiencies and economies are in turn helping Administrations to modernize their telecommunication networks to meet more effectively the growing voice/data needs of the business/government user.

To modernize a network in the most cost-effective way, an Administration must first set appropriate network performance objectives for both near term and long term. The key requirement is to set the objectives so as to balance the performance of all disciplines of the network. The next step is to identify the most economical plan for developing an efficient network to meet the objectives. The Administration must analyze a wide range of technical and economic issues, quantify the impacts of multiple interactions between them, and evaluate tradeoffs for different modernization alternatives. The high efficiency/economy associated with alternate routing and selected large SPC exchanges with remote switching capability must be taken into consideration in the evaluation. Alternatives should be compared by their life cycle costs expressed in terms of the present worth of expenditures, and not by the initial capital costs. Since this is a highly complex task, software planning tools should be used so that a large number of alternatives can be identified and evaluated quickly and accurately.

Network services made possible by the advent of CCS should be provided as early as possible to meet the voice/data communication needs of today's business/government customers. The planning of these services should be an integral part of the overall network modernization plan. By offering network services in a timely manner, an Administration will be well-prepared to meet the challenges of the increasingly competitive marketplace.

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REPORT ON THE PRESENT SITUATION OF OSI DIFFUSION ACTIVITIES IN JAPAN

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1. Abstract

It is essential to supply products conforming to OSI in order to diffuse OSI standards. To promote the supply of such products, selection of more specific protocol based on OSI standards, (subsetting), preparation of functional standards, and conformance test for interconnection to OSI must be conducted.

Here OSI diffusion activities in Japan will be introduced.

2. ACTIVITIES TO INSTITUTE DOMESTIC STANDARDS

Setting standards up is fundamental to promote OSI. Although we have JIS (Japan Industrial Standards) as domestic standards in Japan, OSI standards will be eventually instituted as JIS after being discussed at JISC (Japan Industrial Standards Committee), a national organization to deliberate domestic standards.

JISC established special committee for standardization of information technology in 1969 to conduct extensive research and deliberation of standards in the fields related to information processing and data communication including hardware and software.

The committee has suggested approaches to be taken that will promote the information technology including OSI. They are: 1) speedier establishment of specifications; 2) a stronger functional basis for setting up specifications; 3) obtaining a better understanding of user demands and requirements; 4) providing quidelines for standardization and 5) fast publication of JIS proposals.

Standardizing work at JIS corresponding to that at ISO is carried out by various Technical Committees, equivalent to SCs at ISO and by several JIS Draft Preparation Committees which are formed subject by subject.

As for work conducted in 1985 to institute JIS, JIS drafts were prepared by "LAN-JIS Working Group" at JIPS (Information Processing Society of Japan) and "OSI-JIS Working Group" at JSA (Japanese Standard Association) (See Fig. 1). This section of the report introduces the present state of JIS drafts preparation activities. Table 1 shows how much of OSI standards have been instituted as JIS.

(1) OSI-JIS Draft Preparation Work

OSI-JIS Draft Preparation Committee has been engaged in the work to make OSI standards Japanese standards in concert with worldwide standardization movements. Standardizing work in 1985 was conducted by the following three working groups formed under the Draft Preparation Committee:

OSI-JIS Draft Preparation Committee

- WG1 (Architecture)
  - Addition of CL (connectionless) type data transmission to the Basic Reference Model (IS 7498/DAD)
  - Service convention (TR (Technical Report (DP8509)))
- WG2 (Session)
  - Service definition (IS 8326)
  - Protocol specification (IS 8327)
- WG3 (Transport)
  - Service definition (IS 8072)
  - Protocol specification (IS 8073)

(2) LAN-JIS Draft Preparation Committee

This Committee is engaged in a three-year program, starting 1984, of setting JIS on LAN, and submitted "Interim Report on JIS Draft Prepared in 1984" to the Agency of Industrial Science and Technology in the spring of 1985. The report describes standardizing work regarding LLC, CSMA/CD and TOKEN/BUB.

The committee consists of three working groups:

LAN-JIS Draft Prepartion Committee

WG1	8802/2 (LLC)
WG2	8802/3 (CAMA/CD)
WG3	8802/4 (TOKEN/BUB)

3. ACTIVITIES TO DIFFUSE OSI STANDARDS

It is essential to supply products conforming to OSI in order to diffuse OSI standards. To promote the supply of such products, selection of more sepcific protocol based on OSI standards (subset), preparation of functional standards, evaluation using model systems and conformance test for interconnection conforming to OSI must be conducted.

In Japan, a seven-year National R & D Project started in 1985, by efforts of industry community, NTT and ETL, to meet the above-mentioned needs. Among manufacturers, too, and organization called Promoting Conference for OSI, formed in November 1985, has been engaged in OSI standards promotion, cooperating with other groups such as SPAG and COS.

(1) Promoting Conference for OSI (POSI)

POSI was established by six Japanese computer makers (NEC, Hitachi, Fujitsu, Mitsubishi, OKI and Toshiba) as an equivalent organization to SPAG (Standards Promotion and Application Group) in Europe. In Japan, however, since such work as preparation of secific functional standards, protocol selection and conformance test are left to INTAP (Interoperability Technology Association for Information Processing), and organization formed to pursue the R & D Project, POSI has been conducting policy decision and information exchange among manufacturers.

Information exchange and mutual cooperation with makers in Europe and USA including SPAG and COS are also important areas of POSI's activity. POSI intends to promote OSI by influencing other OSI related groups such as INTAP with the results from these activities.

(2) Large-Scale R & D Project on Interoperability Technology

MITI's large-scale R & D project, "Computer Interoperable Database System" extending over a period of seven years started in 1985 and INTAP (Interoperability Technology Association for Information Processing, Japan) was organized at the end of 1985 to promote the project. The purpose of the project is to establish the basic network system technology conforming to OSI which enables interconnection of heterogeneous computers and also to develop advanced distributed database systems incorporating such elemental researchs as multimedia technology and highly reliable technology.

In fiscal 1985, the project team was scheduled to carry out the survey and overall design on the following items:

a) Distributed Database System Technology
  - a technology to use distributed different databases as one large database.

b) Multimedia Technology
  - a technology to highly utilize multimedia information such as document, graphics, image and voice.

c) Highly Reliable Technology
  - a technology to implement highly reliable information system incorporated with fault tolerant and security provisions.

d) Interoperable Network System Technology
  - a technology to interconnect and interoperate information equipments and systems.

From 1986 on the project team is scheduled to start the research and development of basic network systems based on the previous surveys and conceptual design and to put forward the research and development of each elemental technology.

(3) OSI Interconnection Research Committee

Before starting the Large-Scale R & D Project outlined in (2) above, the following OSI interconnection researches were conducted and the schivements were incorporated into the Large-Scale R & D Project.

This committee was organized in 1985 by a commission of Agency of Industrial Science and Technology, Ministry of International Trade and Industry. Its business affairs are handled by JSA/INSTAC (Information Technique Research and Standardization Center).

On the implementation of OSI protocol products, the committee has been conducting its activities premising that it determines practical subsets of the transport and session protocols which have a wide choice of OSI protocol capabilities and therefore a special guide line should be set for the interconnection design.

Communication types the committee premises are communication between two computers as well as communication between a terminal and a compute as illustrated in Fig. 2.

The committee has defined four types of services as a premise to consider subsets (See Table 2). Type 3 was left out of the committee's research objects as this type applies to the communication between two terminals such as teletex terminals. As for Types 1 and 2, the committee has decided to wait and see the international trend of the standardization because considerable amount of work has been done for their standardization at ISO. The committee, practically, focuses its research on the Type 4 (Service of transaction processing) and is schduled to compile a report by the end of fiscal 1985.

Achievements of the committee is to be incorporated into MITI's (Ministry of International Trade & Industry) "Large-scale project" in 1986.

4. OSI APPLICATION TO PUBLIC NETWORK

(1) JUST

JUST (Japanese United Standards for Telecommunications), communication systems recommended by the Ministry of Posts and Telecommunications, consists of the systems listed in Table 3.

Although these communication systems conform basically to CCITT's recommendations, Japan's own systems such as "Recommended Communications System for Personal Communication Equipment" and "Recommended Communication System for Electronic Mail Communication" are intended to be established. Fig. 3 shows the comparison of communication systems included in JUST with OSI layer structure.

This section briefly describes personal computer communication systems and personal computer electronic mail systems as well as their trends. In these fields, standardization of personal computers is advancing very rapidly.

(a) Personal computer communication system
"Recommended Communication System for Personal Computer Communication Equipments", notified in December 1984 has widely spread, for various manufacturers and software houses are developing and introducing many products based on the notification. As the communication system spreads, the Ministry of Posts and Telecommunications is receiving requests asking for simplification of communication adapter interface and for the function which simultaneously permits data communication and telephone call. To cope with these requests, the ministry notified "Revised Proposal on Communication system for Personal Computer Communication Equipments" in september 1985.

In the above proposal, following functions are added:

1) a type of personal computer adapter device (three-wire handshake, character coding interface, etc.)

2) function which allows switching to voice service mode during data communication and then switching back to data communication mode later.

3) a function with which an adapter accepts arbitrary SPDU when a personal computer is provided with other functions than BCS+ED of OSI session protocol.

(b) Personal computer electronic mail
Ministry of posts and telecommunications is expected to notify "Recommended Communication system for Electronic Mail Communication" at the end of fiscal 1985 based on the survey results compiled in March 1985 by "Research Group on Office Information Communication Network."
This personal computer electronic mail system allows access to "Electronic Mail system" and "Bulletin Board system" via telephone network, and was developed based on CCITT's MHS (Message Handling System).

(2) INS Protocol Research Group

INS Protocol Research Group was organized in the fall of 1984 with NTT as leader, having men of learning and experience as well as related manufacturers as its member in order to contribute to smooth development of INS (Information Network System) service in Japan. The concept of INS service is the same as that ISDN (Integrated Service Digital Network) of CCITT. During fiscal 1985 the group acted briskly toward protocol standardization.

The group consists of three technical groups and the Fig. 5 shows the field of the research conducted by each technical group.

TEC : Terminal Control Equipment
GW : Gate way and the like
WS etc. : Work station and the like

* Field of research

1 First Technical Group
Field related to INS low-level protocol which enables a pass setting between user facilities and INS network.

2 Second Technical Group
Field related to INS high-level protocol which enables communications between user facilities after having set a pass via INS network.

3 Third Technical Group
Field related to INS in-plant communication protocol which enables communications mainly within user facilities in PBX and LAN.

This section briefly describes "INS protocol kernel" discussed by the Second Technical Group and "MHS interconnection experiments" which the Third Technical Group intends to conduct.

A. INS Protocol Kernel
In INS service, the range of the protocol indispensable to ensure the communication between user facilities via INS network has been selected. That range is called the INS protocol kernel. The range to apply the INS protocol kernel is as follows:

1) Communication type
  - between user facility and INS network
  - between user facilities

2) Network structure
  - INS network
  - analog telephone network
  - DDX (Digital Data Exchange) network

3) Low-level protocol
Interface and various types of standard low-level protocol determined by network.

4) Service model
  - conversation service
    e.g. message exchange between a terminal and a computer
  - non-conversational service
    e.g. file and job transfer between computers

INS protocol kernel consists of session layer and transport layer and provides half-duplex transmission and full-duplex transmission as a connection-oriented transmission.
INS protocol kernel is classified as follows:

1) Half-duplex type kernel

2) Full-duplex type kernel

Session protocol consists of the following two types:

1) Half-duplex type: Kernel + half-duplex capabilities + exception notice capabilities

2) Full-duplex type: Kernel + full-duplex capabilities

Table 4 shows the comparison of the two types.

Class 0 has been adopted as a transport protocol.

B. Interconnection experiments

Third Technical Group has been engaged in preparatory work for interconnection experiments in order to evaluate the possibility of implementation and applicability of MHS profile this Technical Group intends to determine. Such experiments are scheduled to start in the spring of 1986.

As shown in Fig. 6, the sphere of the interconnection covers communications between NTT in-plant mail system and mail systems developed by various manufacturers or communications between various vendors' mail systems.

Specifications for the interconnection are based on "MHS Interconnection specification for Business Office", now under discussion at the Third Technical Group.

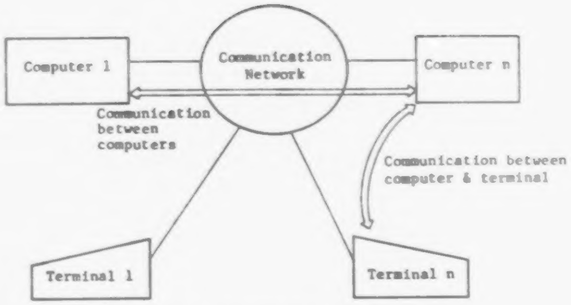

Computer 1
Communication Network
Computer n
Communication between computers
Communication between computer & terminal
Terminal 1
Terminal n

Fig. 2 Communication Type

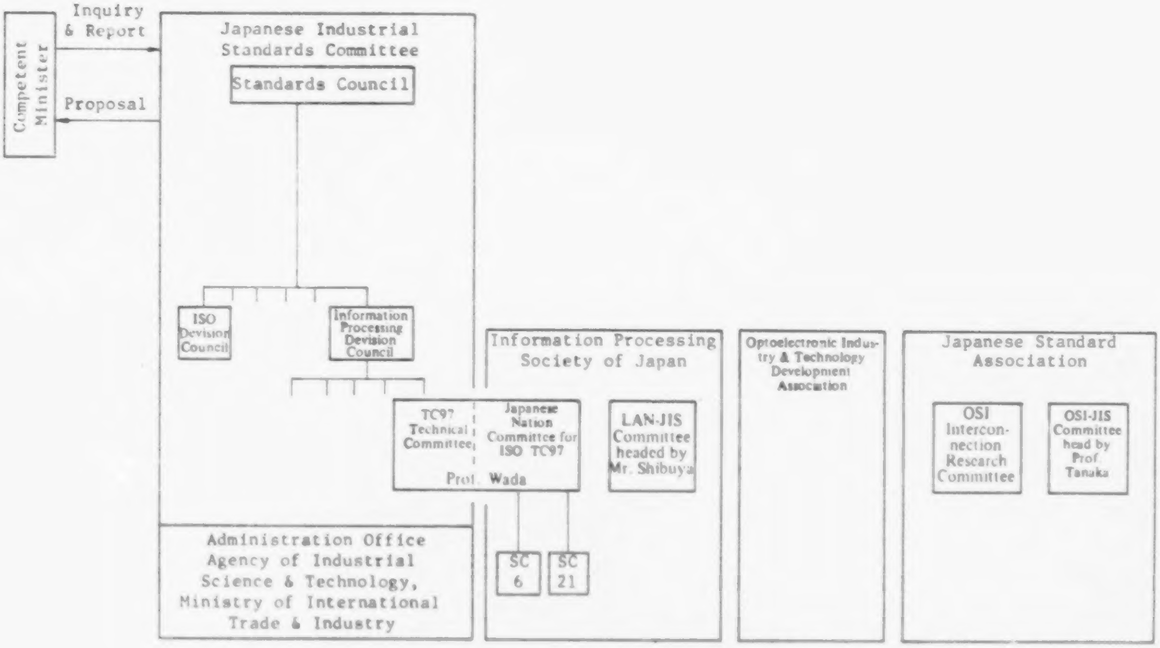

Competent Minister
Inquiry & Report
Proposal
Japanese Industrial Standards Committee
Standards Council
ISO Devision Council
Information Processing Devision Council
TC97 Technical Committee
Japanese Nation Committee for ISO TC97
Prof. Wada
Administration Office Agency of Industrial Science & Technology, Ministry of International Trade & Industry
Information Processing Society of Japan
LAN-JIS Committee headed by Mr. Shibuya
SC 6
SC 21
Optoelectronic Industry & Technology Development Association
Japanese Standard Association
OSI Interconnection Research Committee
OSI-JIS Committee head by Prof Tanaka

Fig. 1 Organization Chart Regarding JIS Network

Table 1 Progress of Work to Make OSI Standards JIS

Layer	JIS standards	Standards currently in process of work	ISO Standards/CCITT Recommendations not yet undertaken
Architecture	JIS C6371-85 (IS 7498.X.200) Basic Reference Model of Open Systems Interconnection	IS7498/DAD CL type data transmission TR (DP8509)(X.210) Service convention	
7. Application Layer			DIS8571/1-4 File transfer DIS8831/8832 Job transfer DIS9040/9041 Virtual terminal DIS8649/8650 Common Application service element
6. Presentation Layer			DIS8823 Service definition DIS8824 Protocol specification
5. Session Layer		IS8326 (X.215) Service definition IS8327 (X.225) Protocol specification	
4. Transport Layer		IS8072 (X.214) Service definition IS8073 (X.224) Protocol specification	DIS8072/DAD1 CL service definition DP8602 CL protocol specification
3. Network Layer			DIS8348 (X.213) CO service definition DIS8348/DAD1 CL service definition DIS8473 CL protocol specification
2. Data Link Layer	JIS C6363-78 (IS 3309) Frame Configuration of High-Level Data Link Control Procedure JIS C6364-78 (IS 4335) Procedure of High-Level Data Link Control Procedure	JIS C6372-85 (IS 7478) Multi link procedure DIS 8802/2 LAN-logical Link Control	
(Continued)	JIS C6365-78 (IS 6159) Procedure Class of High-Level Data Link Control Procedure	DIS 8802/3 LAN-CSMA/CD DIS 8802/4 LAN-Token Passing Bus	DIS8802/5 LAN-Token Passing Ring DIS8802/7 LAN-Slotted Ring
1. Physical Layer	JIS C6361-~~82~~/71 (IS 2110) Interface (25 pins) between data circuit terminating equipment and data terminal equipment JIS C6366-82 (IS 4903) Interface (15 pins) between data circuit terminating equipment and data terminal equipment JIS C6367-82 (IS 4902) Interface (37/9 pins) between data circuit terminating equipment and data terminal equipment		

Table 2 Service Type

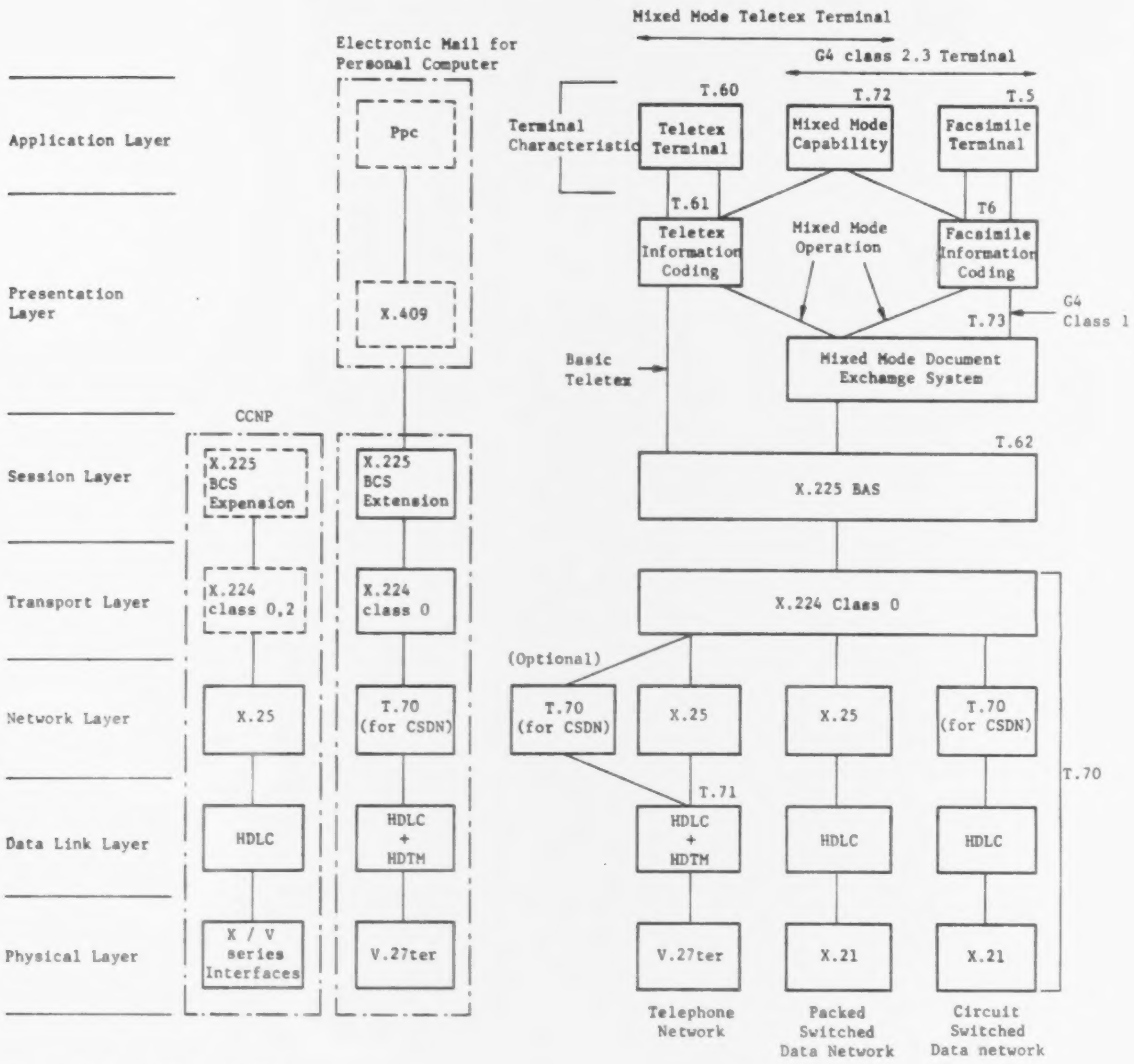
Item	1) File Transfer Type	2) Message Communication (Store and Forward) Type	3) Message Communication (Real-Time) Type	4) Transaction Processing Type
Features of Traffic	Long telegraphic message, One-way continuous transfer	Mix of Type 1) and Type 4)	Long/short telegraphic message, One-way continuous communication	Short telegraphic message, Two-way alternative transfer
Example of Application	Firm banking, RJE	Electronic Mail	Teletex, Facsimile	Database retrieval various banking applications, TSS

Objective model studied by the committee

Table 3 Communication Systems included in JUST

Equipment, Communication System	Summary	Period of Notification	Remarks
Facsimile G2 equipment	Medium speed facsimile equipment using telephone line	Oct. 1979	
Facsimile G3 equipment	High speed facsimile quipment using telephone line	Nov. 1981	
CCNP *	Communication system between two computers and between computer and terminal	Nov. 1980	Scheduled to be revised with in fiscal 1985
Japanese language teletex euqipment	Equipment with communication facility added to Japanese language word processor	Nov. 1983	Revised in March 1985
Personal computer communication equipment	Communication system between two personal computers using telephone line	Dec. 1984	Revised in March 1985
Facsimile G4 equipment	Superhigh speed facsimile equipment using data communication network	March 1985	
Mixed mode communication system	Communication system of document in which characters and graphics are mixed	March 1985	
Personal computer electronic mail communication system	Electronic mail communication system using personal computer as a terminal	Sometime in fiscal 1985	
Telewriting device	Device which enables user to send hand writen graphics in real time while talking over the telephone	after fiscal 1986	

* Computer Communication Network Protocol


Mixed Mode Teletex Terminal
G4 class 2.3 Terminal
Electronic Mail for Personal Computer
Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer
Ppc
X.409
CCNP
X.225 BCS Expansion
X.224 class 0,2
X.25
HDLC
X / V series Interfaces
X.225 BCS Extension
X.224 class 0
T.70 (for CSDN)
HDLC + HDTM
V.27ter
Terminal Characteristic
T.60
Teletex Terminal
T.72
Mixed Mode Capability
T.5
Facsimile Terminal
T.61
Teletex Information Coding
Mixed Mode Operation
T6
Facsimile Information Coding
G4 Class 1
T.73
Basic Teletex
Mixed Mode Document Exchamge System
T.62
X.225 BAS
X.224 Class 0
(Optional)
T.70 (for CSDN)
X.25
X.25
T.70 (for CSDN)
T.71
T.70
HDLC + HDTM
HDLC
HDLC
V.27ter
X.21
X.21
Telephone Network
Packed Switched Data Network
Circuit Switched Data network

BAS : basic activity subset

BCS : basic combined subset

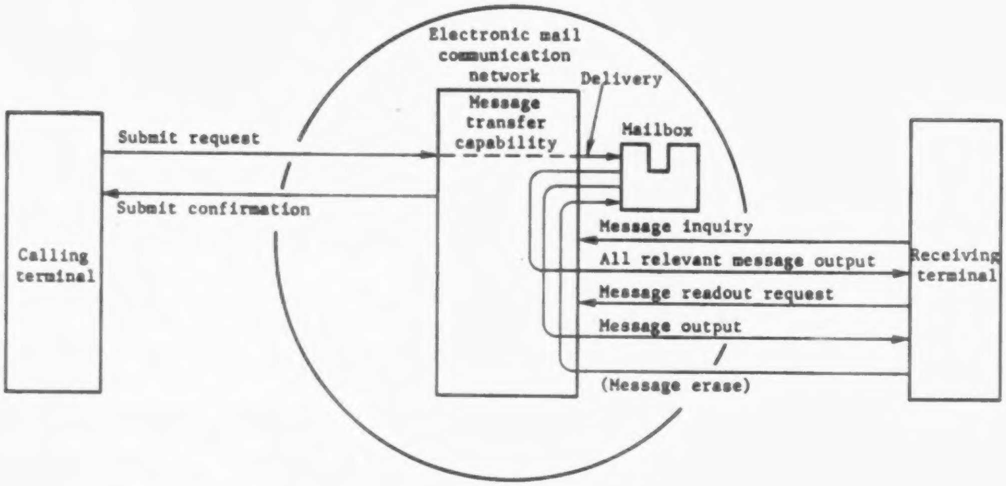
CSDN: circuit switched data network

HDLC: high-level data link control

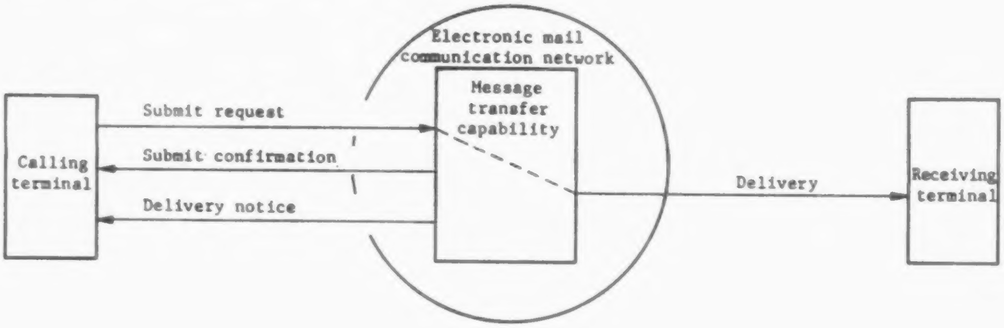
HDTM: half duplex transmission module

Fig. 3 Recommended Communication System as Compared with OSI

(a) Electronic Mail (Communication Type 1)


Electronic mail communication network
Message transfer capability
Delivery
Mailbox
Submit request
Submit confirmation
Calling terminal
Message inquiry
All relevant message output
Message readout request
Message output
(Message erase)
Receiving terminal

(b) Electronic Mail (Communication Type 2)


Electronic mail communication network
Message transfer capability
Submit request
Submit confirmation
Delivery notice
Calling terminal
Delivery
Receiving terminal

(c) Bulletin Board System

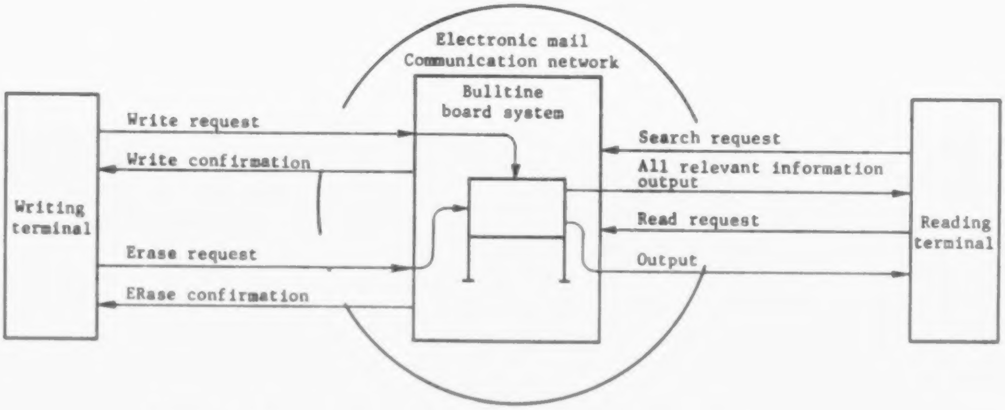

Electronic mail Communication network
Bulltine board system
Write request
Write confirmation
Writing terminal
Erase request
ERase confirmation
Search request
All relevant information output
Read request
Output
Reading terminal

Fig. 4 Communication Types Prescribed by JUST·MHS

(Capability of Bulletin Board System is optional.)

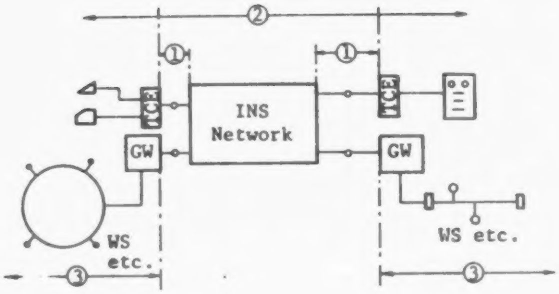


Table 4 Session Protocol Capabilities

Number	Function Unit	Summary of Capability	INS Protocol	
			Full-Duplex Type	Full-Duplex Type
1	Kernel	Establishment and release of connection	○	○
2	Negotiated Release	Negotiation of connection and its release		
3	Half-duplex	Control of transmitter for communication	—	○
4	Full-Duplex	Full-duplex communication	○	—
5	Expedited Data	Transfer of expedited data		
6	Typed data	Transfer of typed data		
7	Capability Data Exchange	Exchange of capability outside activity		
8	Minor Synchronize	Insertion of check points (Minor synchronization point)		
9	Major Synchronize	Insersion of check points (Major synchronization point)		
10	Resynchronize	Restart of data transfer from a check point		
11	Exceptions	Asynchronous notice of exceptional status	—	○
12	Activity Management	Management of different logical pieces of work called activities		

○ : INS' Protocol kernel

— : Unable to select

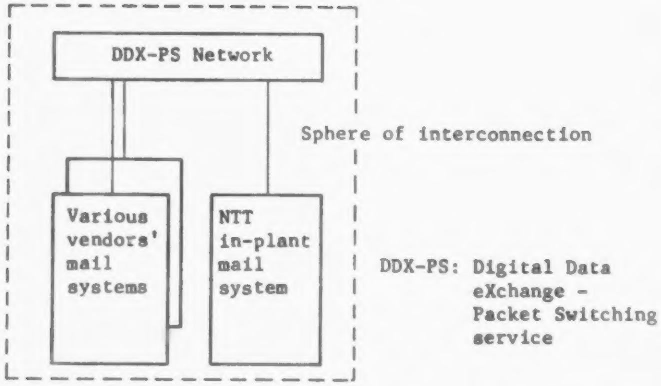

DDX-PS Network
Sphere of interconnection
Various vendors' mail systems
NTT in-plant mail system
DDX-PS: Digital Data eXchange - Packet Switching service

Fig. 6 Sphere of Interconnection Experiments

DIGITAL RADIO MULTIPLE ACCESS SUBSCRIBER SYSTEM (DRMASS)

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1. Abstract

The Digital Radio Multiple Access Subscriber System (DRMASS), a radio system which has been developed to provide various communication services between subscribers and a local exchange in rural or suburban areas, is outlined in this paper. DRMASS provides a number of dispersed users, located far from local exchanges, with telephone and other data communication services by using sophisticated digital microwave technology. This paper presents system configuration, operating principles and applications of the DRMASS.

2. INTRODUCTION

Recently, expansion of telephone services to subscribers in rural areas is becoming one of the most important subjects of government concern in various countries, and the demand for data communications is rapidly increasing and spreading from urban areas to suburban areas in pace with the prevailing ISDN idea. In an attempt to realize such a communication network with economy and flexibility in rural or suburban areas, Digital Multiple Access Subscriber System (DRMASS) has been developed.

DRMASS is a point-to-multipoint microwave radio system operating in the 2.3 ∿ 2.5 GHz radio frequency band and can connect a local exchange with a total number of 512 subscribers distributed in the subject area up to 300 kilometers from the central base station.

In covering the subscribers dispersed in various locations, depending on the geographical situation, DRMASS utilizes a combination of homogeneous and in-line allocation of unit cells as shown in Fig. 1.

With this cellular configuration, DRMASS makes it possible to establish telephone and data links between subscriber terminals and a local exchange with great economy and flexibility.

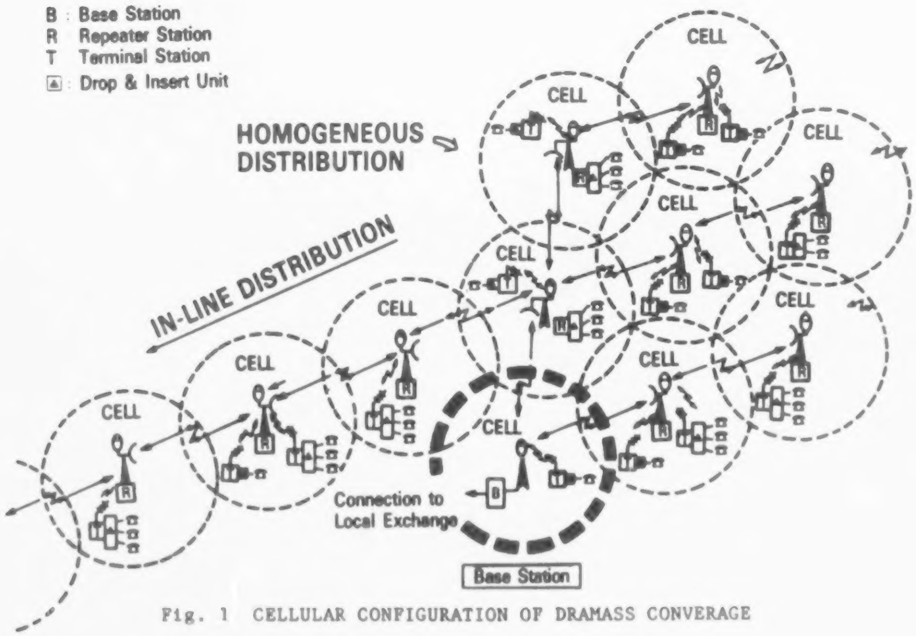


Fig. 1 CELLULAR CONFIGURATION OF DRAMASS CONVERAGE

3. SYSTEM OUTLINE AND FEATURES

3.1 System Outline

DRMASS comprises one base station with repeater stations and terminal stations.
A maximum of 512 subscribers connected to terminal stations are collected at one local exchange in the base station using time division multiplex (TDM) and time division multiple access (TDMA) techniques as shown in Fig. 2.
512 lines from the local exchange are concentrated by the concentrator into 60 telephone channels, that is, 60 time slots in a 4 Mb/s digital stream and distributed to the subscribers in the terminal station.

The demand assign multiple-access (DAMA) operation technique enhances the flexibility of the system design which enables each terminal to accommodate any number of subscribers of up to 64 voice-equivalent channels.
The grade of service DRMASS can provide with the help of the concentrator is less than 1 percent (Blocking Probability) assuming the busy hour call rate is 0.09 erlang per each one of 500 subscribers (See Fig. 3)
Utilizing an omnidirectional antenna, only one pair of point frequencies shown in CCIR frequency allocation plan (Fig. 4) is used in cell for downward (base station to terminal stations) and upward (terminal stations to base station) transmission.
Twenty (20) pairs of frequencies can be allocated, but not to adjacent cells, to avoid frequency interference as shown in Fig. 4.

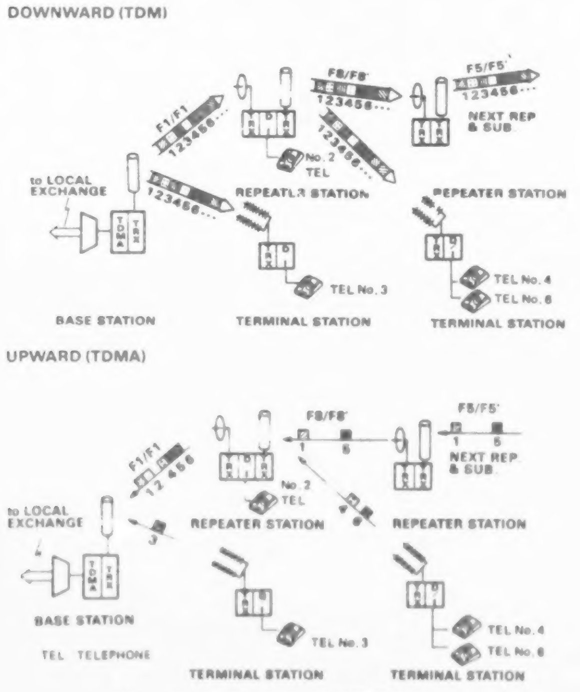

DOWNWARD (TDM)
to LOCAL EXCHANGE
TDMA
TRX
F1/F1'
123456...
F8/F8'
123456...
F5/F5'
123456...
NEXT REP & SUB.
No. 2 TEL
REPEATER STATION
REPEATER STATION
TEL No. 3
TEL No. 4
TEL No. 6
BASE STATION
TERMINAL STATION
TERMINAL STATION
UPWARD (TDMA)
to LOCAL EXCHANGE
F1/F1'
123456
F8/F8'
1
5
F5/F5'
1
5
NEXT REP & SUB.
No. 2 TEL
3
REPEATER STATION
REPEATER STATION
BASE STATION
TEL TELEPHONE
TEL No. 3
TEL No. 4
TEL No. 6
TERMINAL STATION
TERMINAL STATION

Fig. 2 TDM/TDMA TEQUENIQUE

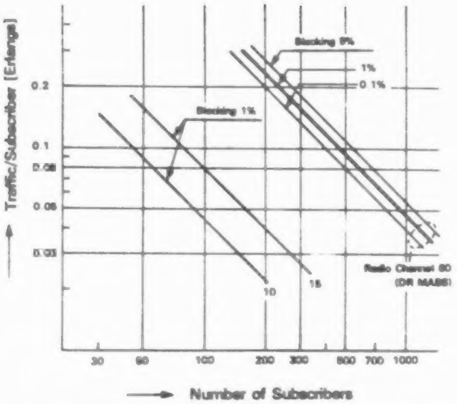


Fig. 3 NUMBER OF SUBSCRIBERS -VS- CALL RATE

Omnidirectional antenna, parabolic antenna and Yagi antenna are utilized for microwave transmission between three types of station to establish the cellular configuration.
In order to expand the potential for users, the service of DRMASS ranges from ordinary telephone to diversified services such as, data and telex transmission, coin telephone, leased lines, priority line, automatic call back and intra-cell function.
In addition to the above, DRMASS provides the features described over leaf.

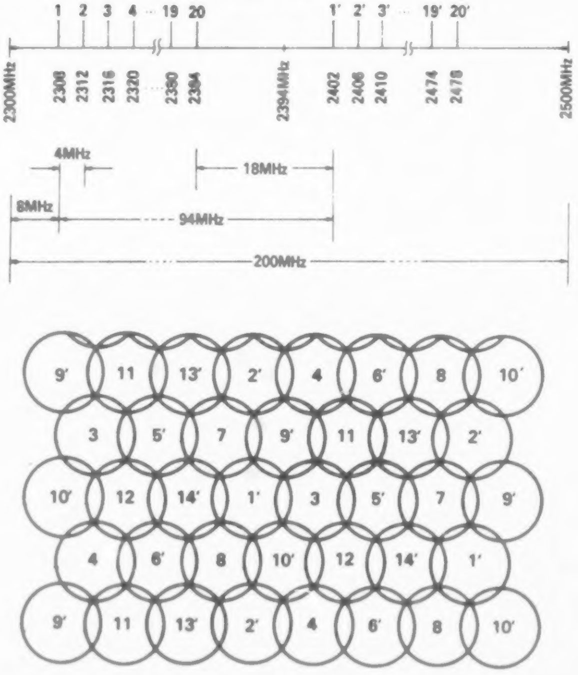

1
2
3
4
19
20
1'
2'
3'
19'
20'
2300MHz
2308
2312
2316
2320
2380
2384
2394MHz
2402
2406
2410
2474
2478
2500MHz
4MHz
18MHz
8MHz
94MHz
200MHz
9' 11 13' 2' 4 6' 8 10'
3 5' 7 9' 11 13' 2'
10' 12 14' 1' 3 5' 7 9'
4 6' 8 10' 12 14' 1'
9' 11 13' 2' 4 6' 8 10'

Fig. 4 FREQUENCY ALLOCATION PLAN

Low Power Consumption

- Combination of battery saving operation and LSI technology results in a significant reduction in power consumption.
- Use of solar power in repeater and terminal stations provides for an almost maintenance free power system.

Powerful Operation and Maintenance Facilities

Features such as self-diagnosis, remote control and monitoring capabilities make overall system operation and maintenance straight forward and economical.

High Reliability

High reliability is assured by the use of LSI circuits and other state-of-the-art devices developed by NEC.

3.2 Details of Operation

Fig. 5 shows basic structure of DRMASS. The system is composed of four main unitis: concentrator and base unit in base station, repeater station and terminal station.
The following briefly describes the operation of each functional unit.

BASE STATION

1) Concentrator

The concentrator is generally installed at the local existing exchange station and it provides 2-wire interface with up to 512 subscriber line circuits of the local exchange. The concentrator concentrates 512 telephone lines, and converts them into 60 time slots in two 2 Mb/s TDM data streams. The concentrator contains duplicated Concentrator Processor Units which, under a stored program control, perform the call sequence and execute the remote supervision of a complete system.

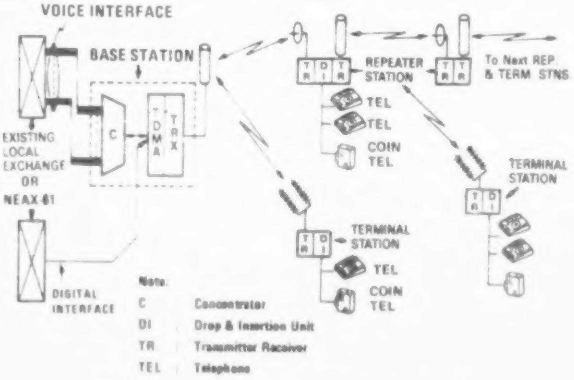

VOICE INTERFACE
BASE STATION
EXISTING LOCAL EXCHANGE OR NEAX-61
C
TDMA
TRX
DIGITAL INTERFACE
T R
D I
T R
REPEATER STATION
To Next REP & TERM STNS
TEL
TEL
COIN TEL
TERMINAL STATION
TEL
COIN TEL
TERMINAL STATION
Note:
C Concentrator
DI : Drop & Insertion Unit
TR : Transmitter Receiver
TEL : Telephone

Fig. 5 BASIC STRUCTURE OF DRMASS

2) TDM CONT Unit

The TDM CONT Unit converts the two 2 Mb/s data streams from the Concentrator to 2.5 M baud radio TDM signal for "downward" transmit path, and reverses for "upward" receive path. The order wire and supervisory/maintenance signals are multiplexed/demultiplexed in the TDM CONT unit. The TDM CONT unit are also duplicated (working and stand-by) for further improved redundancy, The TDM CONT unit is also able to interface directly with Digital Switching System, or NEC's NEAX 61 Exchange at the 2Mb/s stream.

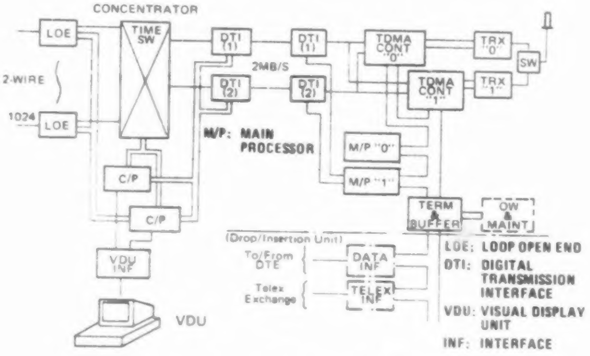

CONCENTRATOR
LOE
TIME SW
2-WIRE
1024
LOE
DTI (1)
DTI (2)
2MB/S
DTI (1)
DTI (2)
TDMA CONT "0"
TDMA CONT "1"
TRX "0"
TRX "1"
SW
M/P: MAIN PROCESSOR
M/P "0"
M/P "1"
C/P
C/P
VDU INF
VDU
TERM & BUFFER
OW & MAINT
(Drop/Insertion Unit)
To/From DTE
DATA INF
Telex Exchange
TELEX INF
LOE: LOOP OPEN END
DTI: DIGITAL TRANSMISSION INTERFACE
VDU: VISUAL DISPLAY UNIT
INF: INTERFACE

Fig. 6 BLOCK DIAGRAM OF BASE STATION

REPEATER STATION

The repeater unit receives the "downward" signal transmitted from the base unit. After regenerating the signals, the repeater unit transmits it on a different frequency not only to a number of subscriber units within its service cell but also to a neighboring repeater unit for further repeating. The signal in the "upward" direction is also transmitted towards the base unit in the same manner.

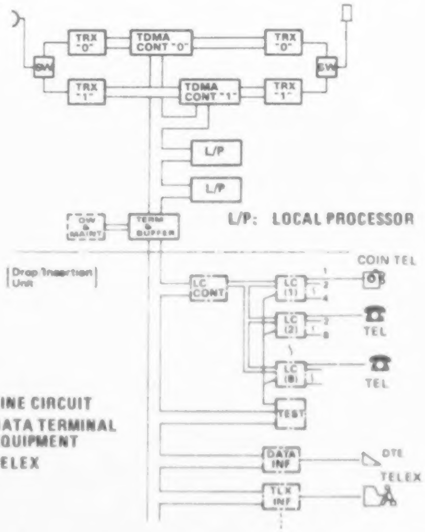

TRX "0"
TDMA CONT "0"
TRX "0"
SW
SW
TRX "1"
TDMA CONT "1"
TRX "1"
L/P
L/P
L/P: LOCAL PROCESSOR
OW & MAINT
TERM & BUFFER
Drop Insertion Unit
LC CONT
LC (1)
LC (2)
LC (8)
TEST
COIN TEL
TEL
TEL
L/C: LINE CIRCUIT
DTE: DATA TERMINAL EQUIPMENT
TLX: TELEX
DATA INF
TLX INF
DTE
TELEX

Fig. 7 BLOCK DIAGRAM OF REPEATER STATION

The multiple use of repeater units allows the service area to be expanded virtually to any distance without noticeably degrading the signal quality because of digital transmission. For practical considerations, it should be limited to 300 km at maximum and to 8 repetitions. Each repeater unit contains subscriber drop-out units which provide speech channels. These subscriber terminals may be increased up to 64 channels by the extension of line circuits. (See Fig. 7)

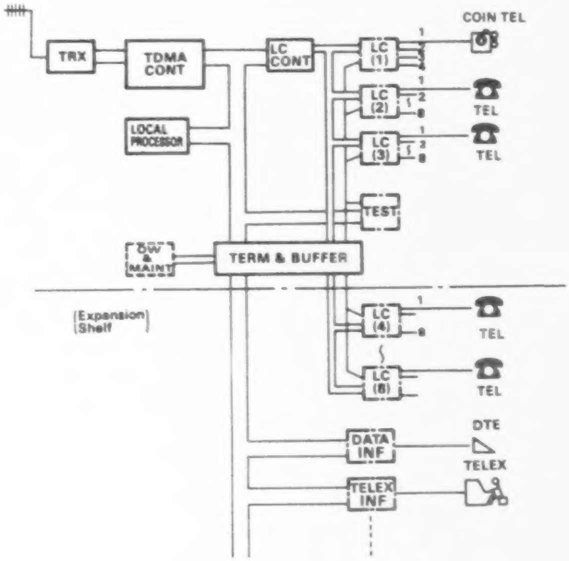


Fig. 8 BLOCK DIAGRAM OF TERMINAL STATION

TERMINAL STATION

The terminal unit consists of a digital radio transmitter receiver and subscriber drop-out unit. Subscriber lines may be increased up to 64 lines from a single terminal unit by installation of an additional extension line circuit.
Due to extremely low power consumption realized by battery saving operation and use of LSI technology, solar powered operation is made possible in terminal stations. The terminal equipment and solar control unit including batteries can be accomodated in a cabinet suitable for installation in an outdoor environment as shown in Fig. 9.

3.3 Centralized Operation and Maintenance

Centralized fully automatic operation and maintenance is realized through a Visual Display Unit (VDU) provided at the base station in DRMASS or at a maintenance center of a public telephone switching network, as shown in Fig. 10.
DRMASS provides the following maintenance capabilities through VDU.

- Diagnostic Tests
- Subscriber Line Test (Insulation resistance/Loop resistance/Capacitance)
- Traffic Statistics Reporting
- Alarm Reporting
- Operation Check of Standby Equipment

All of the above services are automatic and allow the VDU operator to monitor the operating status and test results of the entire DRMASS network.
In addition, future channel re-planning is also possible from information displayed through the VDU.

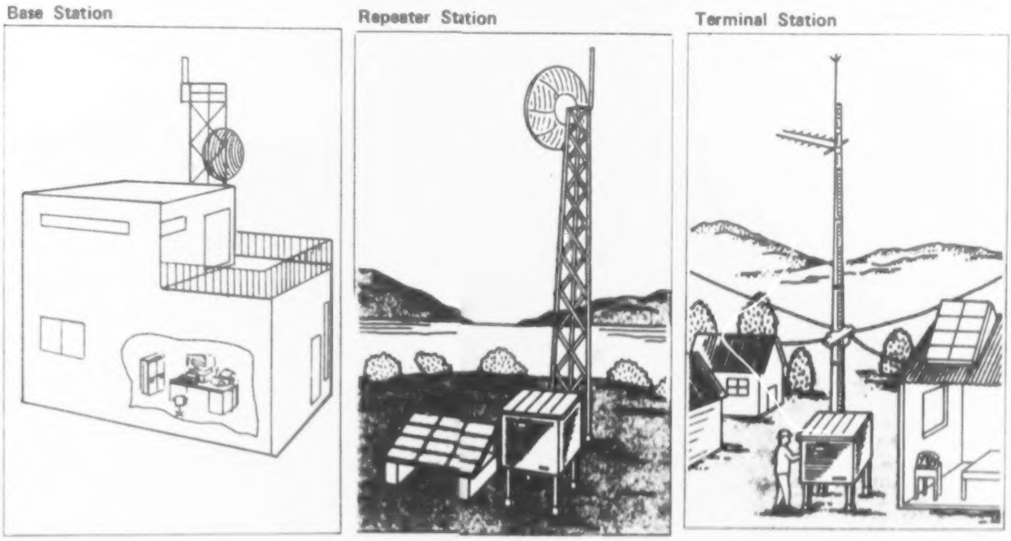


Fig. 9 ILLUSTRATION OF THREE TYPE OF STATIONS

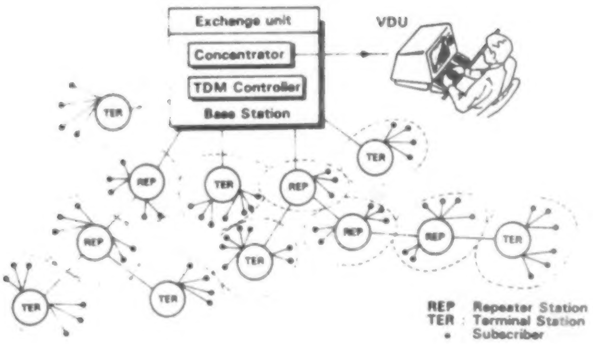

Exchange unit
Concentrator
TDM Controller
Base Station
VDU
TER
REP
REP Repeater Station
TER : Terminal Station
• Subscriber

Fig. 10 CENTRALIZED OPERATION AND MAINTENANCE

With the above functions, 512 subscribers in a 300 km radius service area can be maintained by one maintenance engineer, one technician and one maintenance vehicle with a driver as shown in Fig. 11.

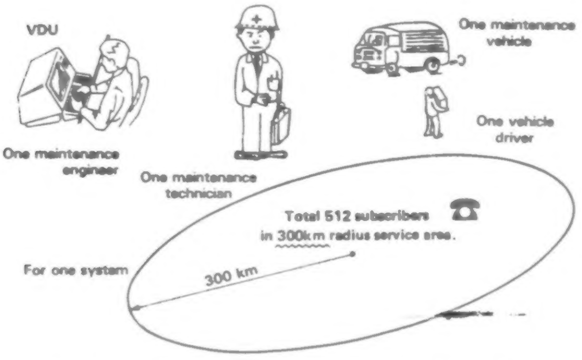

VDU
One maintenance engineer
One maintenance technician
One maintenance vehicle
One vehicle driver
Total 512 subscribers in 300km radius service area.
For one system
300 km

Fig. 11 SIMPLE MAINTENANCE OGRANIZATION

3.4 Data Communication and Optional Services

In addition to basic telephone services, DRMASS can provide point-to-multipoint data communication at virtually any bit rate up to 64 Kb/s as shown in Fig. 12. Data from 2.4 Kb/s up to 64 Kb/s is transmitted through the interface unit of the equipment using preassigned modes. For data transmission at rates below 2.4 Kb/s, a data modem operating on DRMASS telephone circuit is normally used. As an option, DRMASS can also provide the following services to meet the various requirements from different users.

- COIN TELEPHONE
- LEASED LINE
- PRIORITY LINE
- AUTOMATIC CALL BACK
- INTRA CALL
- TELEX SERVICE 40 CH (UP TO 300 BAUD)

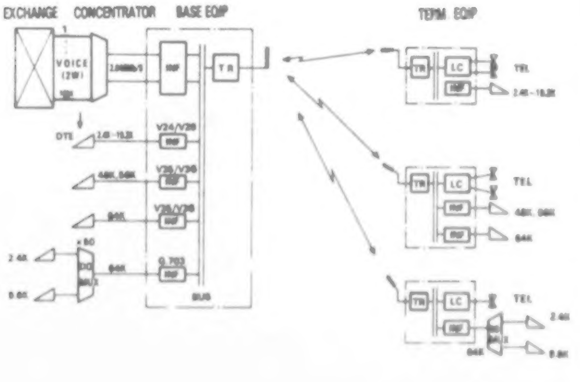
Among the above services, INTRA CALL facility enables an increase in the number of subscribers from 512 to 1024 while keeping the same quality of service.

4. ANCILLARY FACILITIES

Ancillary facilities for the terminal station are also important in achieving total system economy. DRMASS utilizes a small natural-cooling type shelter with solar power unit and a simple 15 m high panzer mast to mount a Yagi antenna.

Standard parameters of the solar power unit are shown below.

- Power Consumption	30 ∿ 60 W
- Solar Power Capacity	270 ∿ 540 W
- Operating Voltage	-48 V
- Holding Time	3 ∿ 7 days


EXCHANGE
CONCENTRATOR
BASE EQIP
TERM. EQIP
VOICE (2W)
TR
LC
TEL
DTE
2.4K–19.2K
V24/V28
48K, 56K
56K
64K
G.703
BUS
TEL
2.4K
9.6K

Information Rate(bit/s)	Interface Conditions
2.4K 4.8K 9.6K 19.2K	• CCITT V.24/V.28 (EIA RS-232-C)
48K	• CCITT V.35 • CCITT V.24/V.11 (EIA RS-449)
56K	• CCITT V.35 • CCITT V.24/V.11 (EIA RS-449)
64K	• CCITT V.35 • CCITT V.24/V.11 (EIA RS-449) • CCITT G.703

Fig. 12 DATA COMMUNICATION IN DRMASS

The shelter is of a natural ventilation cooling type. The dimensions are 1100(W) x 855(D) x 2000(H) mm.
A Yagi antenna can be easily installed on top of the roof, however should there be no room, a 15m-high panzer mast is available.
All of the ancillary facilities described are of a simple construction and available at low cost. (See Fig. 9)

5. SYSTEM AND EQUIPMENT CHARACTERISTICS

System parameters and the equipment characteristics of the DRMASS are summarized below.

5.1 System Parameters

Service Area	
Coverage area	300 km radius
Hop distance, base station to repeater station, repeater station to repeater station	40 km
Hop distance, base station to terminal station, repeater station to terminal station	20 km
No. of repeater stations from base station	8
No. of subscribers	512 (Expandable up to 1,014)
Transmission capacity	4 Mb/s (60 CH)
Traffic parameters	
Busy hour call	0.1 erlang/sub
Grade of service (Blocking probability)	1%
Multiple access technique	
Downward TDM (Time Division Multiplex)	
Upward TDMA (Time Division Multiple Access)	
Demand assigned multiple access	
Radio frequencies	
Frequency band	2.3 ∿ 2.5 GHz CCIR Rep. 933
No. of RF channels	20
Channel spacing	4 MHz
TX-RX shift frequency	94 MHz

5.2 Equipment Characteristics

Transmitter power	
Base station	+30 dBm
Repeater station	+30 dBm
Terminal station	+30 dBm
Noise figure	4 dB
Modulation method	QPSK
Coding and Decording	64 Kb/s PCM CODEC
Demodulation	
Downward	Coherent detection
Up ward	Differential detection
Minimum receiving Level at $BER=10^{-3}$	-92 dBm (typical)
Type of Antenna/Antenna Gain	
Omnidirectional antenna	10 dBi
1.3 mφ grid parabolic antenna	28 dBi
2.4 mφ grid parabolic antenna	33 dBi
45-degree sector antenna	20 dBi
20-element x 2 stack Yagi antenna	17 dBi
Max. No. of D/I units at a repeater or terminal station	64 voice channels or equivalent
Ambient temperature	
Base station	0°C ∿ 50°C
Repeater station	-10°C ∿ 55°C
Terminal station	-10°C ∿ 55°C

5.3 Performance Objectives

Considering system economy in construction of rural networks, the performance objective for long distance digital path recommended by CCIR is applied to the local network constituted by DRMASS. Fig. 13 shows performance objectives in a DRMASS network.

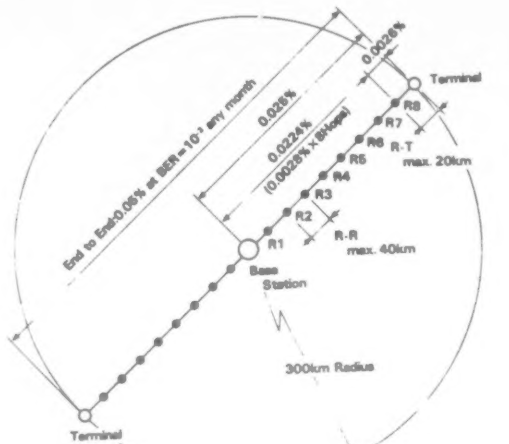


Fig. 13 PERFORMANCE OBJECTIVE

6. APPLICATIONS

6.1 Remote Area Subscriber System

In rural areas, low subscriber populations and vast areas of rugged terrain can make it very expensive to construct wired subscriber lines. Thas's where DRMASS can provide the optimum solution.
For instance when a DRMASS repeater with an omnidirectional antenna is installed in a small village, it can cover subscribers around a 20 - 40 km radius centered at the repeater. And with use of a cellular system, the total area covered becomes about 280,000 square kilometers.
If subscribers are strung out more or less on a line, as along a road or a river, DRMASS can also be used. With the repeater in each small village equipped with a drop and insert unit up to 60 subscriber lines can be handed and DRMASS can connect subscribers of these villages to the local exchange. Add the optional intra-call function and the maximum possible number of subscribers in a system is boosted to 1,024. (See Fig. 14)

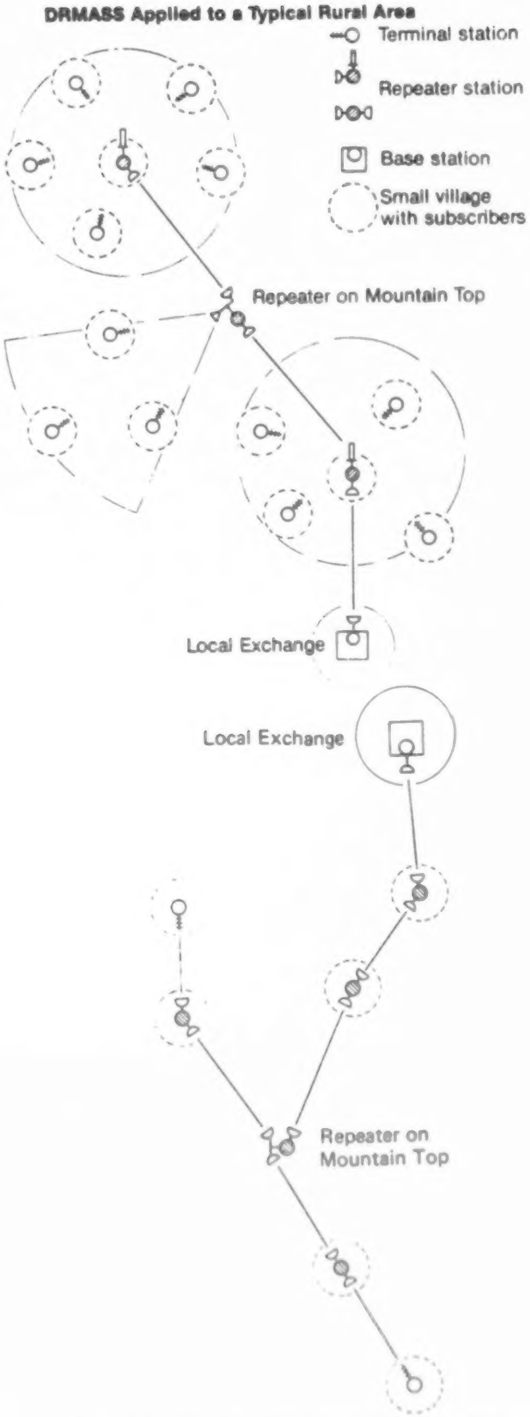

DRMASS Applied to a Typical Rural Area
Terminal station
Repeater station
Base station
Small village with subscribers
Repeater on Mountain Top
Local Exchange
Local Exchange
Repeater on Mountain Top

Fig. 14 DRMASS APPLICATION TO REMOTE AREA SUBSCRIBER SYSTEM

6.2 Suburban Area Subscriber System

Like other areas, suburban areas require not only the usual communications, but also emergency, communications such as police, fire, ambulance, etc. Yet suburban areas offer their own unique problems and among them is the difficulty of forecasting the growth in number of subscribers. In the past, this has caused economic restrictions, delays in the expansion of subscriber lines, or both.
DRMASS is an economical, flexible alternative that allows for network expansion while avoiding unnecessary costs. With its capability of up to 512 subscribers and 64 telex channels per system, DRMASS is ideally suited to handling communications at rapidly expanding suburban sites.

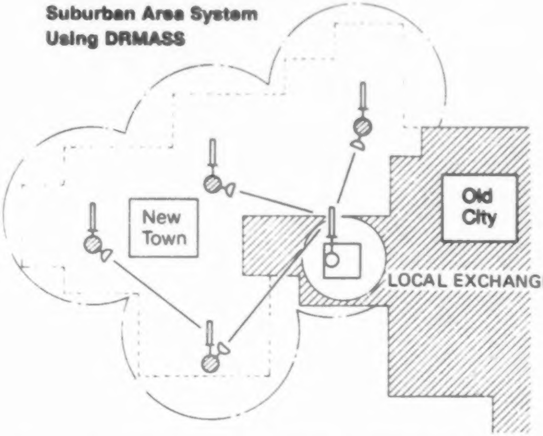

Suburban Area System
Using DRMASS
New Town
Old City
LOCAL EXCHANGE

Fig. 15 DRMASS APPLICATION : SUBURBAN AREA

6.3 Other Applications

The possibilities of DRMASS are further expanded by the availability of temporary and semi-fixed telephone services. These allow DRMASS to be used.

. In a disaster area: after an earthquake, flood, hurricane, etc.

. Where there is a sudden or seasonal increase in traffic: resort, sporting event, etc.

7. CONCLUSION

The DRMASS networks described in this paper are designed to provide various users in rural or suburban areas with telephone as well as data communication services.
The system features a flexibility to meet various geographical conditions with different user requirements, and the centralized operation and maintenance feature enables the so-far-unbenefitted users to achieve a total system economy.

It is expected that the installation of DRMASS systems will contribute to communication facilities and bring extensive services to users in rural areas around the globe.

8. ACKNOWLEDGEMENT

The authors wish to thank Mr. T. Noguchi, Mr. T. Arima and Mr. K. Nagatuna for their guidance and advices in developing DRMASS.

9. REFERENCES

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(2) M. Murakami, et al., "Multiple Access Digital Microwave Radio System for Local Subscribers," ICC'83 B2.5.1

(3) T. Hiyama, et al., "Digital Radio Concentrator System (DRCS)", NEC Res. & Develop., No. 76, Jan. 1985

Statistical Switching Networks
for Intergrated Services

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Abstract

Statistical switching allocates network resources only when actual user bits are transmitted. It provides an efficient implementation for many current and future services, ranging from low to high bit rates and from continous to highly bursty. This paper reviews some of the major arguments for statistical switching. It presents the two basic varieties of this approach: synchronous (as exemplified by GTE Laboratories' Burst Switching) and asynchronous (as exemplified by AT&T Bell Laboratories' Fast Packet Switching) and briefly compares their performance. It shows that several proposed switch architectures can support both varieties of statistical switching.

1. INTRODUCTION

Current switching technology may not be adequate to support new wideband, bursty services. This paper offers a broad overview of statistical switching, which is expected to support a broad range of services in the '90s. Section 2 provides a brief historical perspective of telecommunication services and underlying switching technology. It then anticipates trends in customer premises equipment and applications and deduces the network capabilities that will be required to support user needs.

Section 3 introduces the concept of statistical switching, and shows how it can efficiently extend existing services and support new ones. It further distinguishes between the two basic approaches to statistical switching: synchronous (as exemplified by GTE Laboratories' Burst Switching) (1,2) and asynchronous (as exemplified by AT&T Bell Laboratories' Fast Packet Switching) (3,4). It provides a brief comparison of the trade-offs corresponding to those two approaches.

Section 4 examines some requirements that statistical switching imposes on the performance of an underlying switching fabric, and briefly reviews several solutions to this challenge.

The conclusions are summarized in Section 5.

2. NETWORK SERVICES and SWITCHING TECHNOLOGY

In the beginning the network provided voice grade connections over circuit switched facilities. In the '50s users started to attach modems to those circuits in order to transmit digital data. In the '60s users realized that this approach resulted in a very low utilization of the circuit, especially if it connected a dumb terminal to a remote main-frame, and used statistical multiplexers to concentrate the sparse bursty traffic from many terminals into one circuit. This allowed efficient communications between a cluster of terminals and a single, remote computer center. Packet switching was introduced in the '70s in order to allow equally efficient communications between any terminal and any other terminal or computer. While packet switching achieves its purpose, it results in two separate networks: Packets for interactive data, and circuit switching for voice and continuous transmissions. Efforts to efficently integrate both bursty and continuous traffic have resulted in statistical switching that also offer the TASI (Time Assignment Speech Interpolation) advantage on a network wide basis - i.e., no transport resources are allocated to a call during silence periods. (More on this in the next section).

With the advent of low cost high capacity optical fibers it may seem frivolous to worry about efficient utilization of transmission resources. There are several reasons why this is not so:

1. Telephone companies have huge investments in copper plant, much of it will remain for many years to come. Any technology that augments the existing facilities is welcome.

2. Saving 60% of a 64 kbps circuit on an optical fiber is indeed irrelevant, but if this fiber carries tens, or hundreds of thousands of circuits, then the combined savings may have some significance.

3. Regardless of any savings in transmission resources, combining voice, data and image communications offers added flexibility to the network and its users.

4. The number of cross points needed for N simultanous connections through a switch is roughly proportional to N^2 (though most switches are more efficient than this). Therefore, if the number of active circuits is reduced by a factor of 2 (e.g., for voice with silence detection) or 100 (e.g., for interactive data communications) then the number of cross points in the switch would decrease by a factor of 4 or 10,000 respectively. Even though the costs per cross point are declining, such factors, especially

for large switches, are auite significant.

5. In the future we may expect very high bandwith bursty communications. E.g., high quality variable bit rate teleconferencing, high resolution fast facsimile services, pictorial data base access, and communications with a remote super computer that responds with detailed graphics and animation. Such applications may require one to hundreds of megabits per second for very short durations: a fraction of a second to a few minutes. While saving 60% of a 64 kbps circuit may be immaterial, saving 99% of 100 Mbps circuit is definitely relevant.

3. SWITCHING TECHNOLOGY

Statistical switching can efficiently support bursty applications by allcoting transport capacity, of the desired magnitude, only when it is needed. While a user is quiescent all previously allocated transport capacity becomes available for all users. Due ot the statistical nature of this resource allocation scheme, there is no guarantee that the needed resources will be available upon resumpsion of communications. In such cases some degradation of service (delays, lost bits, recoding of voice or image into lower bit rate formats) may result. In a well engineered network such events will be rare.

Most of the work on statistical switching for integrated voice and data communications starts with the virtural circuit concept: the type of service, the destination, the availability of the called party, billing arrangements and complete routing information are determined at call set up time, and remain unchanged for the duration of the virtual circuit (VC). The details for setting up the virtual circuit, and encoding the routing information vary slightly from one proposal to the next. However, in this paper we focus on what happens after the VC is set.

The more familiar type of statistical switching is asynchronous, as exemplified by AT&T Bell Laboratories' Fast Packet Switching (3,4). With this approach user bits are collected in a packet buffer until the buffer is full or until the user stops transmission (see figure 1). At this point the bits in the buffer, along with a header containing routing and other information are ready to journey across the network. To minimize the waiting time for a packet to arrive at any node within the network, high bit rates links (typically 1.544 mbps) are used between switches. At every node a packet has some probability to find that the required outgoing interoffice link is currently transmitting another packet, or even that more packets are already waiting their turn. Every node will therefore contain queuing buffers. The delay that a packet will experience at any node can not be predetermined. On the average it increases as the offered traffic increases.

At the destination node the packets are placed in buffers from which they are delivered to the user at the appropriate line bit rate. In the case of voice or video communications, where all the bits must be received with the same delay, each packet may be time stamped at the origin, and then delayed at the destination until it has reached the preset constant delay. If the time stamp shows that the packet arrives with too much delay, it may be discarded.

In the case of synchronous statistical switching, as exemplified by GTE Laboratories' Burst Switching (1,2), as soon as the first user bit arrives a circuit switched connection is cut across the switch for the duration of the burst (see figure 2). It is preceded by a header containing all necessary routing information which determine the proper switching. The last user bit is followed by an end-of-spurt flag which releases all the connections previously established for the burst. Initially burst switching was designed to handle a single user bit rate, which is also the network's channel bit rate, typically 64 kbps. In principel it could handle higher user bit rates, in multiples of 64 kbps, by allocating several channels, or several slots per frame, to the same VC. It could also handle lower bit rates by "packetizing" them and transmitting each packet at the network channel bit rate (64 kbps).

Both synchronous and asynchronous statistical switching can be extended to handle arbitrarely large bit rates, provided the needed transmission and switching capacities are available. Both provide full integration of all traffic types (voice, data, image, video) up to the available advantage throughout the whole network.

At a finer level of detail, however, we can distinguish among the two approaches from several performance and throughput characteristics. Some of them are fairly easy to enumerate (5):

1. Delay: Unlike burst switching, packet switching introduces an up front delay, waiting for the packetization buffers to fill up. At 64 kbps user bit rate, and 512 bits per packet, this delay is 8ms. at lower bit rates this delay increases, e.g., to 16 ms at 32 kbps.

2. Reassembly delay: Unlike burst switching, packet switching introduces a reassembly delay at the designation node, in order to assure that all the bits from the same talk spurt are delivered to the user with the same delay.

3. Overhead: The overhead for burst switching is one header and flag per burst. For a typical 400 ms talkspurt at 64 kbps this results in less than 1% overhead. For packet switching, a 56 bit header for each 512 bits packet results in over 10% overhead. This overhead can be reduced by increasing the packet size, but this would increase the packetization delay. The higher

FIGURE 1 - FAST PACKET SWITCHING

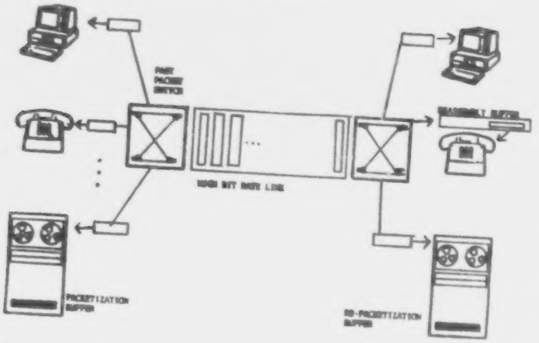
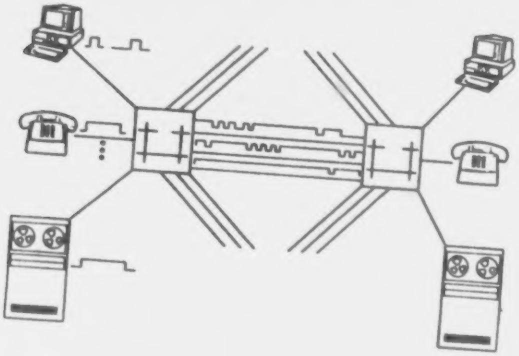

FAST PACKET SWITCH
REASSEMBLY BUFFER
HIGH BIT RATE LINK
PACKETIZATION BUFFER
DE-PACKETIZATION BUFFER

FIGURE 2 - BURST SWITCHING



overhead for packets means that real capacity available for user bits is about 10% less than for burst switching.

Although the above remarks point to some obvious advantages of burst switching, the reader is cautioned that in general fewer user talk spurts will experience any degration (delay or lost bits) in the case of burst switching then in packet switching, but those that do experience such degratation will be more severly degraded in the case of burst switching then in the case of packet switching (6,7).

4. STATISTICAL SWITCHES

In a conventional circuit switch it may take hundreds of milliseconds to set a connection. This is not so bad, because once the connection is established all user bits zip at the speed of light, for the duration of the call. In the case of statistical switching hundreds of milliseconds may be allowed to set up the VC, but whenever new packet or burst arrives to a node it must be switched through in just a few milliseconds. Otherwise the resulting performance for voice communications may be perceptibly lower than for circuit switching. This does not allow any time for routing decisions and switch path configuration by a central processor. Instead, all the routing information must be present in the header of the packet of the burst, and this information is used directly by the switching fabric to establish the proper connection.

Any switch that guarantees a very short delay (say, less than 2 ms per switch) can be used as either synchornous or asynchronous statistical switch. If it is to be used as a multiple bit rate synchronous statistical switch than there is an added requirement that all bits experience the exact same delay through the switch, or at least that the relative order of the time slots (e.g., in a DSI frame) is preserved through the switch.

There are several proposals for such fast switches. They fall into two broad categories: staged networks and loop networks.

Staged networks are exemplified by the small Banyan network shown in Figure 3. When a packet (or burst) header reaches a node, it will be routed through either the upper of lower outgoing link, depending on the value of the first bit in the address field in the header. This bit is not transmitted downstream. Arbitrarley large switching networks can be built up from the 2x2 switching elements.

Another staged network, that resembles an electronic step by step, is used in the ITT System 12 (8). The Starlite Switch proposed by A. Huang and S. Knauer (9) and the broadcast packet network proposed by J. Turner (10) are both powerful staged networks that can handle one to one, as well as many to many and broadcast wideband and narrowband communication.

Another basic topology for a fast switch is ring shaped as in figure 4 (1). It consists of a very high bit rate ring, with add/drop multiplexers as ports. When a burst (or packet) header arrives at a port, either from an incoming link or from the ring, the first byte determines whether it is destined for the outgoing link emanating from this port or not. Accordingly, it will be routed either to the outgoing link (in which case the first address byte will not be transmitted) or to the next port on the ring. This design automatically guarantees that the relative order of the time slots on any incoming frame is always preserved throughout the switch.

5. CONCLUSIONS

Statistical switching promises to support a broad spectrum of services, spanning a wide range of bit rates and varying from continuous to intermittant transmissions. Both the synchornous and asynchronous versions of statistical switching are well suited for the job. Although the synchoronous variety has a slight edge in throughput and performance, many other criteria needed for a complete comparison have not been analyzed yet. There are several ingenious proposals for fast switches that can be used both for burst and packet switching.

FIGURE 3 - A 4X4 BANYAN SWITCH

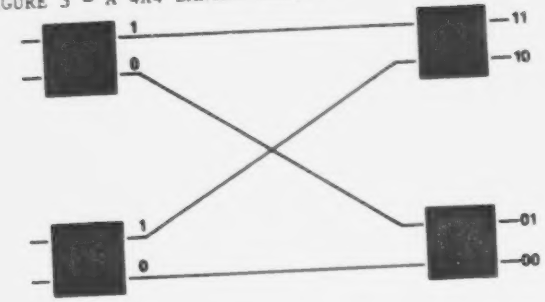
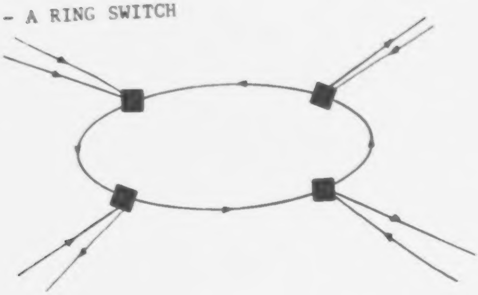

1
0
1
0
11
10
01
00

FIGURE 4 - A RING SWITCH



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Notes

Afternoon Plenary

"Japan's Telecommunications Industry: Our Present Status and the Challenges We Face"

Namio Hashimoto, Chairman
Communications Industry Association of Japan

Notes

Japan's Telecommunications Industry
Our Present Status and the Challenges We Face

Namio Hashimoto
Chairman
Communications Industry
Association of Japan

The rapid reconstruction of Japanese industry which was completely destroyed by World War II can be attributed to the diligent efforts of the Japanese people, their high educational level, their ability to apply science and technology, and appropriate economic policies. In addition, helping hands extended to Japan by various countries of the world including the United States also contributed to our rapid economic rehabilitation. This latter fact must be remembered by Japanese people.

Mr. Theodore H. White, the Pulitzer Prize-winning journalist who died recently, authored an article entitled "The Danger from Japan" in the New York Times Magazine on July 28, 1985. This article was widely read in Japan and evoked a strong response. NHK TV also covered Mr. White's article in its reporting on overseas developments. Please let me quote some passages from Mr. White's article:

"A young lieutenant with the 27th Infantry Division was among the first to land in that week after the surrender; his company had fought in the battle of Okinawa; it had entered with 180 men and come out with only 20. That young combat lieutenant, Malcolm Baldridge, is now Secretary of Commerce, and he recalls the desolation in Japan.

"We sent them", he recalls now, "blood-fractionating technology on humanitarian grounds. Today the company we gave the technology to competes with Americans around the world. We sent them technicians from the Underwriters Laboratory to certify that Japanese products were up to American standards, fit for export. Today U.S. companies fight to get their exports certified for entry into Japan.

"In the 40 years since defeat, Japan has grown to be a giant. Japan has passed the Soviet Union in industrial production and stands as World Class No. 2 to our No. 1. If the present Japanese expansion of production continues, it will be, in 20 years, a greater industrial power than the United States.

"In a few days in Washington, one can trace a trail of irritation blistering under the bland rhetoric that still binds the Pacific alliance together. Start at the State Department with middle-level officers who deal daily with the Japanese - and one hears language almost unheard elesewhere in that labryinth of quiet diplomats. "Japan," said one, who asked not to be identified, "is a protectionist nation: they have no sense of moderation; they are aggressive. They are an island nation looking out on the rest of the world as plunder from a protected bastion. Negotiations are tedious, painful - oh, so painful - and when they yield, they yield with no grace. It's not only quotas on beef, citrus fruits, leather, but even on our catsup and peanut butter."

"In 1981, they banned American metal baseball bats. We had the technology for making a safe cap for metal bats. The Japanese made a metal bat with plastic plug top; a plug flew off at a baseball game and struck a spectator. So all metal bats, safe and dangerous, were banned. We negotiated for three years, we had to get them to change 18 laws and regulations; we had to get the consent of the Japanese Softball Association. Then, when the Japanese learned to make safe metal caps, they reopened the market. Last year, we finally managed to export 350 metal bats to Japan!"

Peace, of course, is primordial. But the Japanese share the same peace, and under our protection, paying little for it, reserve the right to press American livelihoods to the wall. How far or how deeply they can press their trade strategy before Congress explodes in anger in unknown. But it would be well for the Japanese to remember that if peace is paramount, they need us to keep the peace more than we need them. And if a ripple of depression forces Congress to act, a lockup of the open American market would wound Japan more than it would wound us. The superlative execution of their trade tactics may provoke an incalculable reaction - as the Japanese might well remember of the course that ran from Pearl Harbor to the deck of the U.S.S. Missouri in Tokyo Bay just 40 years ago."

This article is painful for a Japanese to read. But unless we Japanese acknowledge that Mr. Theodore White is expressing sentiments shared by many Americans at the grass roots level regarding America's trade with Japan, I do not believe we will be able to properly cope with the situation ahead.

The results of the mid-term elections which took place in November 1986 showed the emergence of a new power structure in the U.S. Congress. Fifty-five Democrats versus forty-five Republicans now occupy Senate seats, and two hundred sixty Democrats versus one hundred seventy-five Republicans sit in the House of Representatives. The election of many Democrats critical of President Reagan's free trade policies and supportive of protectionist policies, particularly applicable to U.S. trade with Japan, is taken by Japanese to indicate the future course of Japan-U.S. trade. Here again, the recent elections confirm the pervasiveness of the grass roots sentiments expressed by Mr. White.

CIAJ: Consistent Supporter of Free Competition Internationally and Domestically

Premier Nakasone visited Washington in January, 1985 and was surprised that specific trade items were included on the agenda by President Reagan, because the President had never before taken up individual industrial sectors with the Premier. The President specified four areas: communications equipment, electronics, lumber and paper products, and pharmaceuticals and medical devices.

We at the Communications Industry Association of Japan (CIAJ) were rather bewildered that trade in communications equipment was to be taken up as a top-priority item. The U.S. deficit in communications equipment trade with Japan in 1985 was 1.2 billion dollars, accounting for a smaller percentage of the overall 49.7 billion dollar deficit with Japan, than, say automobiles and other products.

However, CIAJ and the Ministry of Posts and Telecommunications (MPT) have taken trade issues very seriously. The U.S. was demanding that Japan dismantle all restrictions on trade and particularly those non-tariff barriers which were unique to Japan.

From the beginning CIAJ has supported the idea of opening both lanes in a two way street for Japan-U.S. trade by removing all restrictions on trade, particularly non-tariff barriers, and by according U.S.-made communications equipment reciprocal treatment in Japan to that accorded Japanese-made equipment in the United States. To implement this policy we concluded honorary membership exchange agreements with our counterparts in the United States, the North American Telecommunications Association (NATA) in 1983 and the United States Telecommunications Suppliers Association (USTSA) in 1984. We promoted friendly relations with the U.S. Electronic Industries Association and the American Electronics Association in various activities including mutual visits, meetings and press releases.

Furthermore, CIAJ took the lead among Japanese industrial organizations in opening its membership to foreign enterprises in 1984. The membership of CIAJ as of November 30, 1986 was composed of 199 regular members and 17 supporting members, including 9 foreign affiliates. At present, included in the CIAJ membership are U.S. enterprises such as Japan IBM, Japan Motorola, Rockwell International Overseas Corporation Japan, AT&T International Japan, and Japan Tandem Computers. Northern Telecom Japan, a Canadian enterprise, and European enterprises such as Japan Philips, Siemens and Alcatel, are all participating in CIAJ on a footing equal to Japanese enterprises.

Allow me to focus, now, on other contributions made by CIAJ. In February 1985, the annual USTSA convention and showcase was held in New Orleans. This event coincided with the inauguration of the U.S.-Japan "MOSS" communications equipment talks. At the USTSA convention, Mr. Haruo Ozawa, President of CIAJ, delivered a speech entitled "Cooperation between USTSA and CIAJ in Strengthening Japan-U.S. Electronics Ties". In his speech, Mr. Ozawa disclosed that he had submitted to Japan's MPT the following CIAJ resolution concerning Japan's then pending new technical standards and certification procedures for telecommunications equipment:

1. Technical standards set by MPT under the new Telecommunications Business Law to become effective in April 1985 must be kept to a minimum.

2. The importance of telecommunications equipment standardization will increase more than ever before. Therefore, technical standards should be in accord with international standards set by ITU.

3. Certification of terminal equipment should be based upon examination of relevant documents or data, and should not require testing of actual products.

4. Technical standards and certification procedures should be set according to generally accepted practices in other advanced countries such as the United States.

Mr. Ozawa's speech was widely reported in Washington. On March 22, 1985, CIAJ Washington representative Mr. Stanton D. Anderson received a letter from Mr. Lionel H. Olmer, Under Secretary of Commerce. Mr. Olmer stated: "I admire the strong stand of the CIAJ, particularly since it is so supportive of open markets."

Free Trade in Telecommunications Products:
Cornerstone of CIAJ Policy

I emphasize that the Japanese telecommunications industry advocated an open market and established Japan's current competitive telecommunications market on its free will. The basis for our decision is the notion that free and open trade policies are the foundation of cooperation and development for the world, that equal access to our markets is a natural consequence of our equal access to other markets, and that as far as the telecommunications industry is concerned, our technological ability and productivity are so competitive that we do not need any protective measures such as government regulations, tariffs and non-tariff barriers.

The first MOSS negotiations were held on January 29, 1985, followed by a meeting in March, two sessions in June, and the fifth in August, and agreement was finally reached on "matters concerning telecommunications equipment", "matters concerning telecommunications services" and "matters concerning radio communications equipment and services".

On January 10, 1986, the "Japan-U.S. Joint Report on MOSS Negotiations" was issued by Foreign Minister Abe and Secretary of State Schulz. This report states that all problems raised in the course of negotiations were substantially resolved and that the talks on the telecommunications sector resulted in great success. Japanese technical standards were finally reduced from 53 to 21 items. Through this process, the CIAJ position expressed in New Orleans has been entirely realized. Furthermore, Japan abolished, even prior to the United States, its customs duties on telecommunications equipment.

Dynamics of Change:
Japan's Domestic Communications Industry in New Competitive Environment

On April 1, 1985, three Telecommunications Reform Laws went into effect in Japan. Our century-old telecommunications regulatory system, which had been based upon the principle of monopoly, was fundamentally transformed to allow for competition. CIAJ supported this legislation and played a major role in promoting its enactment.

CIAJ, therefore, has urged that MPT not allow Nippon Telegraph and Telephone Corporation (NTT) to manufacture telecommunications equipment. CIAJ also requested that sales of terminal equipment by NTT should require MPT's approval as proposed in the original legislation. NTT, naturally, made the contrary request of MPT. Thus, CIAJ and NTT differ in opinions in this respect.

In the course of deliberations on the original bill, the section concerning NTT's business activities was amended, and our request was denied. Under an MPT ordinance, however, any business in which NTT engages must be operated without cross-subsidies, maintaining a balance between revenues and expenses. In this connection, disputes have arisen between NTT and manufacturers over the purchase price paid by NTT to manufacturers of terminal equipment. MPT, as the regulatory authority, has conducted hearings to obtain the industry's views and has given NTT its advice and guidance. As a result of CIAJ's efforts competition is gradually emerging in the domestic Japanese marketplace.

There is another important aspect of relations between CIAJ and NTT. NTT's construction investment has remained practically unchanged for the last several years. This is a real problem for us because we will be left behind other countries in the worldwide trend to digitization and ISDN, and because advances in our technological level could be hindered. Therefore, CIAJ has urged that NTT increase its construction expenditures.

Concurrently, the Japanese government established the "domestic demand expansion" policy as a part of its external trade policy. Accordingly, the Cabinet in April required that NTT enlarge its construction program for fiscal 1986 by 150 billion yen which will be expended from the budget for the existing three-year digitization program. Although the Cabinet decision has not been implemented yet, it appears to be good news for both domestic and foreign manufacturers.

Yen Shock: Additional Pressures on the Communications Industry in Japan

Allow me now to touch upon the effects of the appreciation of the yen on the Japanese economy. The yen-dollar exchange rate was 241 yen to 1 dollar in September 1985 and had become 163 yen to 1 dollar on November 20, 1986. The drastic appreciation of the yen has had a more serious impact on many sectors of our economy than did the oil crisis in 1970's. The impact on the export industry has been particularly destructive. Combined sales of our telecommunications manufacturing companies in 1985 were 1.845.4 billion yen of which domestic private demand accounted for 33%, NTT and public sector demand 35%, and exports 32%. In other words, domestic private demand, NTT and public sector demand, and exports each accounted for approximately one-third of the total. According to experts, this was a stable situation enabling diversification of risks.

The high speed growth of our telecommunications manufacturing industry over the last several years was largely attributable to an increase in exports, particularly exports to the United States. The rapid and drastic yen appreciation, the decline in growth of the U.S. telecommunications equipment market following the AT&T divestiture, and the increased exports by countries other than Japan, particularly by NICs, have all caused a relative decrease in exports from Japan. In the closing accounts for the first half of fiscal 1986, every CIAJ member company recorded a substantial decrease in sales as compared with the same period of the previous year. Most companies recorded considerable decrease in profits by 50% or more, and some companies showed a deficit.

So the telecommunications manufacturing industry which experienced continued high growth in the past, has now entered the winter period. The greatest challenge we are now facing is how best to cope with this situation.

On September 8, 1986 when views and opinions among industry representatives were exchanged on the issue of the high yen at the Industrial Problems Study Committee (chaired by Eiji Toyota) of Keidanren (Federation of Economic Organizations), CIAJ suggested the following measures be used to solve the problem: (1) effect cost reduction through drastic rationalization, (2) reduce prices on exports, (3) expand overseas procurement so as to import more components and products, (4) expand production in foreign countries, and (5) expand domestic demand (including NTT procurement). CIAJ stated before the Committee that this was the time when drastic measures must be taken, while being careful to not bring about the "hollowing" phenomenon in our companies in our eagerness to reduce production costs by depending on overseas production. CIAJ also suggested that appropriate government economic policies were required to solve problems brought on by the appreciation of the yen.

As a result of the restructuring of Japan's telecommunications market to allow increased competition, brought about by enforcement of the three Telecommunications Reform Laws on April 1, 1985, is that the Japanese domestic telecommunications equipment market is gradually expanding. That is to say, demand for telephones and other terminal equipment is steadily increasing, while demand for network equipment is also increasing with the advent of five new Common Carriers and inauguration of their business services. On the other hand, however, as competition has become more intense, a decline in prices has occurred, and profit rates have declined in direct proportion to the decline in product prices.

Orders for telecommunications equipment during January through September 1986 remained almost unchanged as compared with the same period of the previous year. Exports of telecommunications equipment from Japan during January through September 1986 decreased by 10% as compared with the same period of the previous year. Exports to the United States during the period decreased by 28%, while imports from the United States decreased by 8.8% during the period. Therefore, when compared it is clear that imports to Japan show a relative increase over exports from Japan. As a result, the export-import ratio which was 10.1 to 1 during January through September 1985 became 8.3 to 1, approaching better balance. Taking a look at our export of telecommunications equipment by item, every item showed a decline. In particular, a remarkable decline was observed in standard telephone, automatic answering equipment, telex and facsimile.

Communications Industry: Technological Development Is Key To Continued Vitality

We in the telecommunications manufacturing industry are responsible for restoring vitality and achieving new growth in the industry by adopting appropriate measures, in order to cope with the higher yen value, and by establishing a more stable currency exchange rate.

In Japan, telegraph service started in 1869, and telephone service in 1890. As to our switching system, the magneto switching system was introduced in 1980, the step-by-step automatic switching system in 1926, the crossbar switching system in 1955, and the electronic switching system in 1984.

Regarding transmission systems, Dr. Shigeyoshi Matsumae developed the non-loaded carrier cable system in 1932 which was put into service between Japan and China in 1938. The coaxial cable transmission system was developed in 1956, the medium-capacity optical fiber cable transmission system in 1981, and the large-capacity optical fiber cable transmission system in 1984. In the field of radio communications, the microwave radio communications system was developed in 1954, the medium-capacity geostationary satellite for experimental use was put to trial in 1977, and the satellite communications system by a CS-2 Satellite, the first working communications satellite, was developed in 1983.

Our telecommunications technologies have now reached world-class levels as a result of our having introduced superior foreign technologies for practical use, while at the same time having developed our self-initiated technologies such as the non-loaded cable carrier system developed by Dr. Matsumae, and by our having integrated these technologies. Furthermore, our nationwide telecommunications network providing universal telephone service and versatile, new, enhanced services throughout Japan has been developed as a national infrastructure. As we opened our doors earlier to the world in the field of trade, we will also promote open and cooperative relationships with each country of the world in the field of technology as well. Moreover, we will continue to contribute to world peace, eliminating national boundaries in the telecommunications industry which is intrinsically international. We will make every effort to promote mankind's happiness.

On May 1, 1986, a meeting of Cabinet members in charge of economic affairs drafted an "outline of economic structural adjustment promotion policies", and set a "national policy goal" in order to steadily reduce our current account surplus to make it more balanced internationally. The Cabinet also proposed measures to realize the goal, and established the Economic Structure Adjustment Promotion Headquarters headed by the Prime Minister. The Government's Major Policy Goals are:

1. As medium and long term measures: (a) expansion of domestic demand, (b) conversion to an internationally more-harmonized industrial structure, (c) further improvement of accessibility to our markets and promotion of manufactured imports, and (e) promotion of international cooperation and contribution to world economy appropriate to our international position.

2. As short-term measures: (a) popularization of longer summer vacation and the five-day working week system, (b) lowering the interest rate charged by the Export-Import Bank of Japan for direct investments and manufactured exports, and (c) steady expansion of official development assistance (ODA).

Similarly, the "Basic Plan for Industrial Society in the 21st Century", a report issued by the Industrial Structure Council on May 26, 1986, aims to redress the trade imbalance through expansion of direct investment abroad, expansion of imports, and promotion of international division of labor by encouraging technology transfer. It further aims to reduce the adverse impact caused by adoption of these measures on our domestic economy, such as reduction in employment opportunities, through development of basic technologies and further growth of service industries such as information processing services.

With this vision of the 21st century, and its view towards the conversion of our industrial structure, we intend positively with wisdom and courage to promote continued growth and development in the electronics and telecommunications industries as our key industries.

Afternoon Plenary

"Cultural and Telecommunications Futures in Six Pacific Islands"

Christopher Jones, Barbara Moir and James Dator
University of Hawaii

Notes

207

Cultural and Telecommunications Futures in Six Pacific Islands

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High Technology Research
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1.0 Abstract

Telecommunications development in the Pacific Island Region must be understood within the context of a range of historical, geographical, demographic, and cultural factors. The futures of the Region will be influenced both by technology innovation and the specific cultural contexts of providers and end-users. Telecommunications providers and experts from outside the Region are expected increasingly to have to come to terms with the physical and cultural contexts, as well as to recognize the possible and probable Island futures in their planning for telecommunications development in the Region.

2.0 OVERVIEW AND MAJOR FINDINGS.

This is a paper based on the findings from a detailed report [1] on the current status and alternative futures of telecommunications in six Pacific Island communities: the Republic of Belau, Fiji, the Commonwealth of the Northern Mariana Islands, Papua New Guinea (North Solomons Province), Tuvalu, and Western Samoa. The report, A Study of Preferred Futures for Telecommunications in Six Pacific Island Societies, resulted from research funded by GTE Laboratories and Hawaiian Telephone Company through the Pacific International Center for High Technology Research. Comments about the current status and alternative futures of telecommunications in the entire Pacific Island Region are also included in the report and are summarized in this short paper.

The major findings of the study, in summarized form, are as follows:

(1) While there is considerable variation within and between the communities studied, nearly all are served at present by almost every current telecommunications technology, at least to some extent. However, while a few localities feature some very modern equipment, most have old and obsolescent technologies. The proper use and maintenance of current equipment, as well as the acquisition of more modern technology, represent critical areas of need for all sites.
(2) Modern telecommunications capabilities are very much wanted in the Region. Obtaining modern telecommunications is a specific goal of the Development Plans for each community visited, and generally for the Region as a whole. Virtually all of the people interviewed in the six communities support this goal.
(3) At the same time, most respondents hoped at least to preserve and often to enhance their present, more or less traditional culture, and the physical environment which supports it. However, there was general recognition of the probability that increased and extensive telecommunications technologies might substantially modify their current and traditional ways of life. The tension, if not contradiction, between these two facets is noted.
(4) Assuming the desirability of political, economic, and cultural integration, there is no place in the world where telecommunications capabilities are more appropriate than the Pacific Island Region. Because of the vast ocean distances between the (often) small and isolated communities in the Region, telecommunications, far more than any other factor, can be a major contributor to nation building and community integration for the foreseeable future.
(5) Indeed, it is far more likely that modern telecommunications technologies will increasingly be found in the Region than that they will not. The major questions are: who will provide them, and for whose primary advantage?

3.0 METHODS.

The fundamental method used to carry out research for this study was that of personal interviews, one to three hours in length, with 50 major decision makers and/or users of telecommunications in the six communities. These interviews were conducted and recorded in the field by a two-person research team, and subsequently were subjected to rigorous, comparative content analysis.

In preparation for these interviews, extensive research was conducted utilizing the unique resources of the Pacific Islands library collections and specialists of the University of Hawaii and the East-West Center in Honolulu. While in the field, books, official reports, on-site photographs, and similar documentation not available in Hawaii were also collected; their data were incorporated in the larger study. In addition to data from within the Region itself, some information relating to the regional plans and expectations of actors from outside the Region was collected, analyzed, and included within the study.

4.0 POLITICAL AND ECONOMIC BACKGROUND.

At present, there are nine independent nations in the Region, ranging in population size from over three million for Papua New Guinea and 650,000 for Fiji, to 8750 for Tuvalu and 8400 for Nauru. The remainder of the Island communities are characterized by some kind of dependency relationship with the United States or France (major powers controlling substantial amounts of territory in the Region), New Zealand (supervising three Island communities), Chile (Easter Island), Australia (Norfolk Island), and the United Kingdom (Pitcairn Island, with a population of 53 persons).

While some are substantially better off than others, all of the Island communities have very uncertain economic futures because of their very narrow resource bases, small populations, and geographic remoteness from one another and from the rest of the world. If one uses the conventional economic indicators of development, most of the Islands seem to be very poor indeed. And yet, because of the extremely important role played by the traditional subsistence economy in an essentially unheralded way, the sort of crushing poverty (often accompanied by extreme population pressure) which is characteristic of the rest of the "underdeveloped world" is not generally found in the Pacific Island Region — so far.

Politically, the Region is in the Western camp, especially influenced by the United States and France. Nonetheless, the USSR has recently concluded a few successful diplomatic and commercial agreements in the Region, and is attempting more. The same is true of the People's Republic of China. Japan exerts considerable economic influence now, and this is expected to increase. Australia as well is very important to the Region from an economic standpoint. New Zealand may continue and/or expand its current policy of relative independence from the U.S., and of greater unity with the Region. The status of Micronesia (held by the U.S. as a United Nations Trust since the Second World War) is now being transformed into four different relationships, three of which are termed "free association" with the United States. The territories under French control are experiencing considerable, often violent unrest. Thus the political future of the Region can no longer be presumed essentially to "belong" to the United States and France, as it has since the Second World War.

Economically, all of the Island communities rely more or less heavily on some kind of foreign economic assistance. Average annual per capita income for the Region is US$ 1037. Many people do not participate in the cash economy at all, or do so on an irregular basis. Garden root crops such as taro, manioc, sweet potato, and yam, and tree crops like breadfruit and coconut, are dietary staples. Fish and shellfish provide protein for people living near the sea, as do pigs and birds for residents of the mountain or inland areas.

The government is the largest employer everywhere. Although efforts are constantly made to increase private-sector development, expenditures always grow faster than GNP. All national development plans call for more cash cropping, and most of the nations do export some kind of agricultural product — mainly copra, palm oil, and sugar cane.

The Region has very few of the natural resources sought by industrial nations; the exception would be mineral ores (primarily nickel, gold, and copper) found in Papua New Guinea, New Caledonia, the Solomon Islands, and Fiji.

Tourism is the Region's major industry. Following the establishment of 200-mile exclusive economic zones (EEZs), many of the nations have begun licensing their waters to foreign fleets fishing primarily for tuna.

Potential for additional resources exists in the so-called manganese nodules which lie on the ocean bed. They are not likely to be economically exploitable for many years, however. The continuing improvement and dissemination of OTEC (Ocean Thermal Exchange Conversion) technologies offer greater hope. Not only should substantial amounts of electrical energy be produced by the open-cycle thermal exchange process, but its fresh-water and cold-air byproducts can be used economically for air conditioning, agriculture, and aquaculture as well.

5.0 TELECOMMUNICATIONS FUTURES.

Understanding the present and future of telecommunications in the Pacific involves consideration of the following factors: the historical pattern of regional electronic-communications development; the relationships between former colonial or current metropolitan powers (e.g, aid donors) and the Island nations; and the geographic, demographic, and cultural contexts of communications-systems development.

Rural telecommunications development, particularly rural telephony, is the highest regional priority for telecommunications, as indicated in national development plans [2], in regional planning directives (embodied in the mandate of the South Pacific Telecommunications Development Project [SPTDP] of the South Pacific Forum [3], and the U.N./ITU South Pacific regional telecommunications development activities [4]), and as reflected in the comments and responses of individuals interviewed in six Island states during the course of this study. Rural telecommunications poses a serious problem in terms of conflicting objectives; most Pacific microstates cannot, on their own, afford to develop and provide basic services and transportation to rural areas, and supply a minimal level of telephony to rural areas at the same time.

The dilemma of how to provide services to remote and rural areas reflects the historical character of telecommunications-system development in the Pacific, in contrast to continental developments. It was the physical nature of the Pacific Basin (vast areas; small, dispersed populations; and isolated locations) which necessitated an infrastructure based on radiotelephony (and increasingly, on satellites) rather than microwave and cable trunks. Compensating for these physical constraints, broadcast radio has played a major role in communicating messages throughout the Region. In addition, newly independent nations, in their drive for recognition and economic development, have concentrated first on improving their international telecommunications links; as a result, urban centers have received the lion's share of telephony-infrastructure development funding. Even so, the small scale of telephony and data communications has favored government control and has not justified the development of private networks in most Pacific microstates.

Television is the most controversial contemporary subject relative to regional telecommunications. Introduction of broadcast television is being planned, studied, or debated in most Pacific microstates; for them it is a relatively new phenomenon, although VCRs are proliferating nearly everywhere in the Pacific, especially in urban centers. Foreign television and films are criticized for their negative influence on children, and for their impact on and destruction of culture. That few Pacific Island countries can afford to produce more than a fraction of their own programing, or maintain adequate control (censorship) of incoming programs portraying Western lifestyles and values, are causes for public and government concern. Similar concerns were expressed by respondents with regard to computer programing and software.

Appropriate technology is another high priority for telecommunications development in the Pacific. Photovoltaic and other types of solar technology, jelly-filled cable, and modular digital technologies are examples cited by engineers and users as most suited to hot, humid, often rainy and salty island and atoll environments which are frequent subject to destructive storms. Satellite technology is also viewed as appropriate. Distance-insensitive, high-powered satellites are expected to link small, low-cost, maintenance-simple earth stations by the thousands by the turn of the century.

Local culture and social structure are factors which influence how new technologies are used. Whereas people living in industrialized countries are accustomed from childhood to using telephones, those in areas newly exposed to the telephone — adults as well as children — have no history of experience with such systems. Moreover, in many areas now being connected to the telephone network, the subsistence economy remains strong and economics is a family and communal affair. In areas now undergoing a transition from subsistence to cash economies, there often is insufficient cash to support residential telephone service (given the "customer pays" model of telephony development). Even when cash is available, in cultures where the extended family is still strong it may be an uncle or brother — not the end user — who pays for telephone calls.

Training probably constitutes one of the weakest links in the telecommunications system, despite the admirable efforts of regional training centers. Increasingly, donor corporations and countries are expected to provide training and consulting support for hardware and software. While the tendency has been to send Island personnel to developed countries for advanced training, experience has shown that problem-specific and job-specific consultations for Pacific Island systems may be preferable. Further, staff training requirements are often very different for managers and supervisors in the Pacific than for their counterparts in developed countries. The considerably smaller telecommunications organizations characteristic of the Pacific often require their staff to make more important decisions, and assume greater responsibilities, far earlier than do telecommunications personnel elsewhere.

What do people in the Region want for their future in terms of high technology and telecommunications? The majority of our respondents indicated a desire for most types of modern technology, including the various telecommunications systems — but not at the expense of their traditions and culture. They hope to achieve control over their own destinies; they need telecommunications to serve them, to benefit them, and to loosen the economic ties that bind them to former colonial or current metropolitan powers.

6.0 SOCIETAL FUTURES.

This section presents a brief summary of what respondents said they wanted, did not want, and felt was likely to happen in their societies in the future. The body of the interview involved respondents' picturing desirable, undesirable, and most probable futures for their country, and describing conditions in 12 separate but related "domains" or areas of society, as they would obtain in their three images of the future: JOBS; HOW PEOPLE MAKE A LIVING — NATIONAL ECONOMY — FAMILY RELATIONSHIPS — COMMUNITY AND NATIONAL HEALTH — GOVERNMENT — NATURAL ENVIRONMENT — RELIGION — TECHNOLOGY IN GENERAL — HOUSING; POPULATION CENTERS — MEN AND WOMEN (IN THE WORKFORCE, IN SOCIETY, AND IN RELATION TO

EACH OTHER) — EDUCATION — and INTERNATIONAL RELATIONS. Some comments did not fall within the scope of the 12 areas of questioning, but instead form a grouping which we have termed SOCIOCULTURAL ISSUES.

A sample of the most frequently cited preferences, concerns, and expectations for the future, for all 13 domains of society for the six sites collectively, are presented in brief below. These issues, developments, and continuities represent the most frequently cited items across the range of futures articulated by project respondents in each area of society. While they may apply to more than one of the countries in question, many items are country-specific, and are not representative of the Region as a whole. The sites differ considerably from one another, and the items discussed below should not be inferred to apply universally. In some "societal areas" there were strong differences of opinion even within a single country. Thus, some of the developments, or issues, are inherently contradictory, and should be understood as applicable only within the context of a specific country's background, and/or within the context of alternative futures for the Region -- scenarios which attempt to sort out some of the contradictions in the cultural and technological development of the Region.

DESIRABLE FUTURE. In terms of JOBS; HOW PEOPLE MAKE A LIVING, many respondents advocated that training in fields necessary for national development be made available, and continued participation in subsistence activities. Respondents in two sites wanted limits placed on the number of incoming alien workers. Characteristic preferences for the NATIONAL ECONOMY included: an economy based on "well-developed, well-managed fishing and tourism industries;" and an economy which maximizes economic self-sufficiency, reduces foreign investment, and encourages decentralization of the central government's financial powers. For FAMILY RELATIONSHIPS, a majority of respondents hoped that the extended-family and clan systems would remain strong or or become even more cohesive, as they once were. Regarding COMMUNITY AND NATIONAL HEALTH, it was recommended that there be: more community education and awareness of the importance of nutrition and the environment to people's health, reduced consumption of foreign (canned) food; improved health services and facilities; and better individual self-care. Respondent desires for GOVERNMENT included: greater village and community roles in the national political process; that the political system remain democratic; and that a wide variety of specific public policies be enacted or enforced. In terms of the NATURAL ENVIRONMENT, respondents hoped that it would continue to be able to support people who make a living from environmental resources; that the oceans, reefs, and forests (and/or specific habitats) would be preserved; that reforestation programs would follow any logging developments; and that there will be stronger conservation laws for plant and animal species. The subject of RELIGION elicited considerable difference of opinion among respondents. For example, while there was strong feeling that there should continue to be freedom of choice, on the other hand, it was also believed that people should follow just one religion. Some respondents felt that the number of religions should be limited by the government; many individuals believed that society should maintain strong spiritual values, whatever the religion.

In terms of TECHNOLOGY IN GENERAL, many people favored having more and better roads in the future, improved communications and telephone systems, and other kinds of new technology — but these desires were tempered by the proviso that they be appropriate to Island lifestyles and cultures and be introduced at an appropriate (i.e., not too rapid) rate. A desirable future regarding HOUSING; POPULATION CENTERS was one in which population would be spread more evenly across the island(s), urban drift would be halted, and rural services improved. It was desired that any changes in housing be appropriate (e.g., solar energy) and that local styles be retained. Many respondents also felt that housing should incorporate both traditional and Western features. Most individuals felt that MEN AND WOMEN should have equal opportunities in the future with regard to employment and in leadership roles, although a dissenting view held that women should not assume business and government leadership roles. As for EDUCATION, respondents generally favored more instruction in local languages and culture, and more specific training or increased skills in subsistence techniques and in those aspects of the "outside world" which contribute to their nations' development. In their INTERNATIONAL RELATIONS responses, individuals expressed desires both for continued association with, and greater national autonomy from metropolitan powers (e.g., the U.S., Australia). They also desired improved, autonomous, and more extensive relations with countries in the Region, and many wished to see the Pacific declared a nuclear-free zone. SOCIOCULTURAL ISSUES were discussed by many respondents, who specified a strong desire to preserve and nurture the Islands' traditions, customs, languages, and cultural identities.

UNDESIRABLE. In terms of JOBS, respondents objected to: the continued hiring of alien workers; unemployment; the continued perception of white-collar jobs as high status positions; a continued reliance on government resources (e.g., food stamps) instead of using Island resources; and continued urban drift for jobs. Respondents did not want to see their NATIONAL ECONOMY dependent on external sources of supply — imported goods, aid funds, or foreign expertise. Many were opposed to the presence of foreign fishermen in their country's waters in the future. Individuals expressed concern about

FAMILY RELATIONSHIPS, hoping that the extended-family would not break down and/or give way to a nuclear family structure, or that family ties and obligations would not otherwise weaken or disintegrate. Regarding COMMUNITY AND NATIONAL HEALTH, respondents objected to people being sent overseas for medical treatment; the continuing emphasis on curative as opposed to preventive care; any increase in the number of automobile accidents; and other negative aspects of development reflected in health problems. Concern was expressed regarding the size and extent of the central GOVERNMENT and about the quality of leadership, and many were averse to Western-style "party politics" and bureaucracy. For their NATURAL ENVIRONMENT, respondents did not favor further reef and inshore-area degradation; land reclamation; high-rise construction; tree felling; and further transformation of the landscape due to road construction. While there was widespread concern about the introduction of any more religious groups to the Islands, the following were also considered to be undesirable: for there to continue to be so little value placed on RELIGION in daily life; for people to continue to substitute materialistic for spiritual values; for there to be any religious conflicts in the Islands.

In terms of TECHNOLOGY IN GENERAL, respondents were opposed to nuclear technology; military (or arms) technology; "overcomputerization of business, industry, and education systems;" the negative effects of VCR and television introduction, dependence on energy-intensive household technologies; and the introduction of new technologies at too rapid a pace. As for HOUSING; POPULATION CENTERS, respondents did not want to see greater urban population concentration, overcrowding in residential areas, low housing standards or unavailablity of housing. It was judged to be undesirable for there to continue to be a disparity in the opportunities available to MEN AND WOMEN in employment; continued marital problems and high divorce rates; and traditions which restrict the wife's participation in society outside the home. Respondents did not favor a system of EDUCATION which resulted in the loss of local languages and customs through Western emphases in the local curriculum. A number of individuals expressed concern that children would rely on computers and calculators to think for them in the future. Regarding INTERNATIONAL RELATIONS, respondents indicated that they did not want their country to be too dependent on any other nation for its well-being, yet many also felt it would be undesirable to be isolated from other countries. Many respondents also objected to the domination or exploitation of their country by any other. SOCIOCULTURAL ISSUES of concern to respondents were: continuing to be "spoon-fed, to swallow everything that comes around" from other cultures; losing the knowledge of language, customs, and communal identity; and the adoption of more "individualistic" values.

MOST PROBABLE. In this futures image, there was conflicting opinion on the subject of JOBS. On one hand, it was anticipated that more local people will grow and catch their own food; on the other hand there was widespread expectation that even fewer people would be able to support themselves this way. Similarly, some respondents were certain that more incoming aliens would monopolize the local job market, while others believed there would be more jobs for local people. It was forecast that most people would depend on wage jobs in the future. The future NATIONAL ECONOMY was expected to continue to be dependent on metropolitan aid, and to be influenced by an increase in the number of foreign business owners and in the amount of foreign investment. Optimistic responses included the projection of an improved economy overall with a more productive workforce, although there was considerable difference of opinion as to the degree to which the economy would improve. Most respondents assumed that FAMILY RELATIONSHIPS would neither be as close as they once were, nor as close as they are today, but a dissenting view held that the nation's extended-family structure would persist in the future. Many responses to COMMUNITY AND NATIONAL HEALTH were not optimistic, projecting an overall decline in health treatment and facilities. However, a number of other respondents believed that there would be an improvement in local care services and an overall improvement in community health. With respect to GOVERNMENT, many respondents stated that the political party model would continue, but that "things will be different" due to higher levels of education and the adoption of Western ideas by younger leaders. A number of individuals anticipated that younger leaders will be more open-minded and evironmentally oriented, and that the public itself will be more politically aware in the future. Relative to the NATURAL ENVIRONMENT, respondents forecast a probable deterioration of the land, reefs, and local waters; increased control of land by foreigners; and an increased number of development projects with a corresponding decline in environmental quality. As for RELIGION, many individuals we talked to expected an increase in the number of religious groups entering their country, and believed that there would continue to be freedom of choice in religious preference.

For TECHNOLOGY IN GENERAL, it was forecast that there will be more roads and cars, "more kinds of technology" generally, computerization of businesses and industries, and more and better technologies used in a variety of capacities. In terms of HOUSING; POPULATION CENTERS, respondents anticipated continued population growth and a corresponding increase in housing construction. Also predicted was the continued concentration of population in urban areas, and increased urban drift. MEN AND WOMEN were expected to have greater equality in the future, with women earning better salaries and having more opportunities in employment. In EDUCATION, most people we spoke to believed there will be improvement in the quality of education generally, although the pressure will be toward Western-style education. Respondents were certain that INTERNATIONAL RELATIONS will continue to be important in the future, and that their nation will maintain close relations with and dependence on metropolitan powers for support (i.e., foreign aid) and defense. Regarding SOCIOCULTURAL ISSUES, it was assumed that culture and people will be adversely affected by Western influences, even to the loss of Island cultures and languages. One dissenting view was represented by the statement that Western commerical, materialistic culture is no match for "a [cultural] system that is based on human relations: your value depends on the fact that you're a human being, not on how much money you have in your pocket, not on how many gadgets you have surrounding you."

7.0 ALTERNATIVE FUTURES FOR THE REGION. Five alternative futures for the Region as a whole were drawn from analyses of the material given above.

(1) ACHIEVEMENT OF NATIONAL ECONOMIC DEVELOPMENT GOALS. The "official" future, as derived from the Development Plans of each Island community, is that the goals of development will essentially be reached, and that sustained development (political as well as economic) will be achieved.

(2) REGIONAL SELF-SUFFICIENCY THROUGH REGIONAL COOPERATION. On the other hand, many people within the Region express the hope that a more integrated political and economic unit can be built on the foundation of a pan-cultural "Pacific Way." In this future, while each autonomous nation will retain its independence (and those under foreign control will obtain theirs), transregional organizations such as the South Pacific Commission and the South Pacific Forum will merge and grow. Eventually a "Pacific Islands Community," along the lines of the European Economic Community, will be formed.

Another key element in this scenario is regional self-sufficiency, based upon regionally cooperative national development plans. In addition, the subsistence sector of national economies will be strengthened and emphasized, and those aspects of present development plans which appear to weaken the traditional subsistence sector (and culture) will be eliminated.

(3) INTEGRATION INTO THE WORLD POLITICAL-ECONOMY. This scenario takes the position that the preceding two are irresponsibly romantic and hopelessly unattainable. There is no way the Pacific Island nations, individually or collectively, will be able to achieve economic or political independence. They are too small, too remote, too weak, too ill-informed, and too important to vastly stronger and more skillful outside forces ever to be independent. They will be absorbed (culturally, as well as politically and economically) by various national, and especially transnational, economic forces already at work in, or moving into, the Region.

(4) FOREIGN DEPENDENCY CONTINUES. This alternative future expects the present situation to continue indefinitely into the future. The United States, France, Japan, and other dominant nations will continue to fail either to give the Region its due, or to let it go. The unhealthy dependency and uncertainty of the present will persist because no one in the big nations cares enough about what is happening in the Region, and the small entities there are powerless to act on their own.

(5) BEYOND WORK AND EVOLUTION. The fifth scenario holds that major technological forces — of which telecommunications is only among the first — are sweeping, or about to sweep, over the Region (and indeed, over the globe). These are the forces of the so-called electronic and biological revolutions, primarily, and they will alter behavior, institutions, and values far more quickly and fundamentally than most people understand at present. Future microelectronic technologies will be so small, cheap, "friendly," and "intelligent" that human mental, as well as manual, labor will not be necessary in most areas which require it today; new jobs demanding human strength or attention will not be created. Society will approach full unemployment, as no more than some 10 percent of the current human workforce will be required. As a consequence, many people in the Region will choose to return to, retain, and enhance traditional values and lifestyles.

Advances in biology will alter life processes at an even more fundamental level. Many diseases with a genetic basis will be eliminated. The human body (and that of other animals) will be redesigned. Even the old-fashioned method of human reproduction, and hence the roles of mothers, fathers, and families, will be challenged by true test-tube reproduction and genetic cloning. Control will be achieved over sickness and death. By the early twenty-first century, humans may well be in the process of creating their own intelligent successors.

8.0 CONCLUSION.

Each of these five alternative futures has a reasonable chance of evolving; however, the "real future" is not likely to be any one of the five, but rather to grow out of a combination of the factors emphasized in each. All project an extremely important role for telecommunications. Whatever the future, there is no part of the world for which telecommunications is a more appropriate technology system than the Pacific Island Region.

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Informal Discussion Tables with Keynoters

Notes

Informal Topic Discussion Tables

Notes

Pacific Island Round Table

"Planning the Use of Satellite Transmissions Within the South Pacific Telecommunications Development Programme"

E.J. Wilkinson
SPEC-Fiji

Notes

Planning the Use of Satellite Transmissions Within the South Pacific Telecommunications Development Programme**

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Abstract

The twelve independent island countries who are members of the South Pacific Forum have been working together since January 1984, along with Australia and New Zealand, to plan improvements and extensions to their telecommunications system within a joint South Pacific Telecommunications Development Programme.

From the outset the countries appreciated the importance of satellite transmission methods in establishing trunk connections across long water paths and detailed studies of the "satellite options" have been carried out. These studies have been assisted by discussions and presentations from the three bodies able to offer the hire of satellite space segment facilities either immediately or within the near future: Intelsat, Aussat, Pacific Satellite Inc. (a joint venture US/PNG company planning the establishment of the PacStar satellite network). Assistance has also been provided by many government and non government bodies within and outside the region. The paper outlines the unusual features of the proposed South Pacific usage of satellite transmissions and identifies the environmental, demographic and institutional problems which must be overcome if an adequate but affordable network is to be established.

1. INTRODUCTION - Extension and Improvement of Existing Telecommunication Networks.

The establishment of a regional management group to plan and coordinate the extensions and improvements to the telecommunication systems of the South Pacific Forum countries was an innovative concept of the Governments of the region. Following the holding of the first meeting of the Management Group (a "board" of 28 "directors" - 2 from each of the South Pacific Island countries plus 2 each from Australia and New Zealand) early in 1984, and the appointing of a Program Controller at SPEC to direct the work between Management Group meetings worthwhile progress has been made in the planning of the Program.

The aim of the SPTDP as set out in the original recommendations to the South Pacific Forum was to extend and improve the present telecommunications infrastructures to provide network connected telephones to communities not yet enjoying such service. One quantification of the aim indicated a likely doubling of the telephones per 100 population from the present figure 3 per 100 to a new level of 6 per 100.

Early in the planning of the programme it was appreciated that attention could not be restricted to improving the rural networks alone, that growth in rural subscribers would lead to the need to improve and extend the urban networks. Some Microstates drew attention to the impossibility of identifying separate rural and urban networks in their countries.

2. NON SPEECH TRANSMISSIONS

The main emphasis of the program was to be the provision of telephone services (mainly rural) however two forms of non speech traffic which appeared almost from the beginning of the SPTDP planning are worthy of separate discussion.

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Telegraph & Data Services

Although not considered, originally, to be a large percentage of the total service requirement, the telegraph and data service demand can be seen to be growing as planning for the total infrastructure is advanced. An important element of the data traffic could be "electronic mail" where the delivery of private correspondence by electronic means to remote communities without regular air or shipping services appears well justified on the grounds of plain humanity even if not highly profitable at the outset. The gradual adoption of computer methods in the South Pacific is also generating intercomputer traffic and the capability of the new transmission systems (particularly satellite networks) to provide low cost point to multipoint services is generating demands for one way and two way informations access systems.

Many of these demands are for specialized services in the fields of education (led by the USP Distance Teaching network), meterological forecasting and warnings, emergency health care, marketing, inter country news, etc.

Television

While not identified as a high priority in the original recommendations for the establishment of the regionally coordinated SPTDP, requirements for television services have arisen almost from the outset and are still arising. As a result of concern by some countries that telecommunication developments may fail to provide for television users (particularly in the case of the establishment of satellite small earth terminals for outer island telephone traffic) the 1985 South Pacific Forum Meeting directed the Management Group of the SPTDP to include the planning of the reticulation of television programmes, wherever possible, within its telecommunications planning work.

The August 1986 Forum meeting endorsed proposals from the establishment of a SPEC committee to allow television issues other than the telecommunication related matters to be discussed between the Forum countries.

3. SUMMARY OF PROGRESS

It is a little less than three years since the SPTDP initiative of the South Pacific Forum was begun. Prolonged discussion and negotiations regarding the funding of the program has limited progress with the implementing of the new telecommunication facilities but worthwhile progress has been made in the planning of the methods to be used. Complete success has been achieved in the use of the unusual program management adopted and all participating countries are working within the Management Group with a friendly co-operative spirit to solve not only their own telecommunication development needs, but to help in finding solutions for those of their regional neighbors.

4. SATELLITE CONSIDERATIONS

The many detailed studies of telecommunication requirements in and between the small island nations of the South Pacific over recent years have all concluded that, because of the archipelagic nature of the area, the only affordable method of providing reliable trunk circuits between the island would be to utilize satellite transmission methods.

By the mid 1980's all but two (Tuvalu and Niue) of the twelve Forum countries have been provided with international connections through the Intelsat Pacific Satellite(s) and attention was being directed towards the extension of satellite methods to cover national as well as international services.

As mentioned above, the establishment of the South Pacific Telecommunications Development Program focussed attention on rural services and intensified the search for affordable satellite solutions for the low density telecommunications traffic to the outer islands of the region.

Three available or proposed satellite network options offered by Aussat, Intelsat, and PacStar have been subjected to very detailed investigation culminating in presentations by the three bodies to a meeting of the Management Group of the SPTDP at which each quoted capital costs and space segment hire charges which would be involved in serving a "model" network in which a capital city hub station serves five outer island locations. The qualifications set down in the model include:

- capital costs are radio equipment only on an FOB basis

- all space segment channels are permanently assigned.

A summary of the costs presented to the meeting is shown at Table A. The coverage offered by the three networks are shown in Fig. 1.

After studying the information provided, especially the operational features and costs, the Management Group has reached some broad conclusions:

(a) That any satellite space segment facility offered for use in a South Pacific network must be available for use on both national and regional connections.

This critically important requirement (which had not been so positively identified in the case of some of the earlier domestic/regional satellite networks such as Palapa, Arabsat, etc.) results from the very low traffic densities in even the largest of the South Pacific countries such as Papua New Guinea and Fiji and still lower density of call traffic in the smaller countries.

If the charges for the hired satellite space segment are to be covered by the income from the calls (at tariff rates which the public of the South Pacific can afford) the channels derived within the hired satellite transponder(s) must be shared between all earth stations in the region and be capable of use for both regional (inter country) and domestic (within country) connections.

It must be accepted that regional traffic is international traffic and thus "institutional" difficulties arise in setting up and operating a joint national/regional satellite network in the case of some S. W. Pacific countries.

The fact remains however, that the most desirable design aim for both economic and technical reasons (elimination of two hop transmission) is to evolve a satellite network for the Forum countries (and possible near neighbors) within which every island of any country can establish direct connection through the same satellite with every island of every other country.

This requirement has been established in the main from considerations of telephone traffic but is no less important in the case of non speech traffic such as telegraph and data services and in distributing television and sound broadcasting programs within the South Pacific.

(b) Implicit in the viewpoint that any satellite network adopted for the South Pacific should provide for both national and international connections is the intention, in such a network, to concentrate the traffic offered to the satellite transponder through a DAMA controller to minimize the number of minutes per day that the common pool of hired channels is unused. The converse of this statement is perhaps more important - to hire the minimum number of trunk and international channels necessary to handle traffic offered from a large number of subscribers on separate islands of separate countries and at an acceptable grade of service.

From examples studied by the SPTDP, reductions to as little as one fifth of the optimized permanently assigned channels for a grade of service of .01 may be possible. Such savings are critically important in establishing the viability of satellite connections to the smaller centres of population which must be served over long water paths (and may lead to justification for use of satellite transmissions to locations which could use terrestrial transmission systems along the lines of a recent European paper which considers satellite uses in Africa).

The issues which must be investigated further include:

(i) the study of recent developments in DAMA systems where lower cost controllers with distributed control logic to enable the "all eggs in one basket" problem to be minimized. Time division systems to replace FDM analogue have also been developed and studies of several new products are required.

(ii) the issue of sharing space segment channels and, particularly, sharing ownership of a regional DAMA facility (whether single controller or distributed controllers) raise policies in the telecommunication sector of the participating Governments which are required to be addressed. The financial attractions of regional DAMA operations are so compelling that the prsent institutional barriers should not prevent further discussions and negotiations from proceeding.

(iii) the figures quoted in the PacStar presentation demonstrate the potential savings in capital and recurring costs from use of the optimized network with spot beams to achieve high EIRP transmissions from the satellite and high receive sensitivity in the case of the uplink path.

Evidence from Canada and Australia with smaller spot beam designs also demonstrate similar cost savings. The SPTDP Management Group has also heard that future Intelsat networks will incorporate features such as spot beams for regional networks to compete with non Intelsat networks. The Intelsat presentation includes a network architecture based on Intelsat V-A satellites (1987-89 time frame) where sub networks are operated with DAMA control to achieve optimizations without resorting to spot beams and permitting all S. W. Pacific national and regional traffic to be achieved from the hire of one transponder.

5. CONCLUSION

Further studies of optimization of network design by taking advantage of developments in switching topology and from the utilization of spot beams are now required if the most cost efficient regional satellite system design is to be achieved.

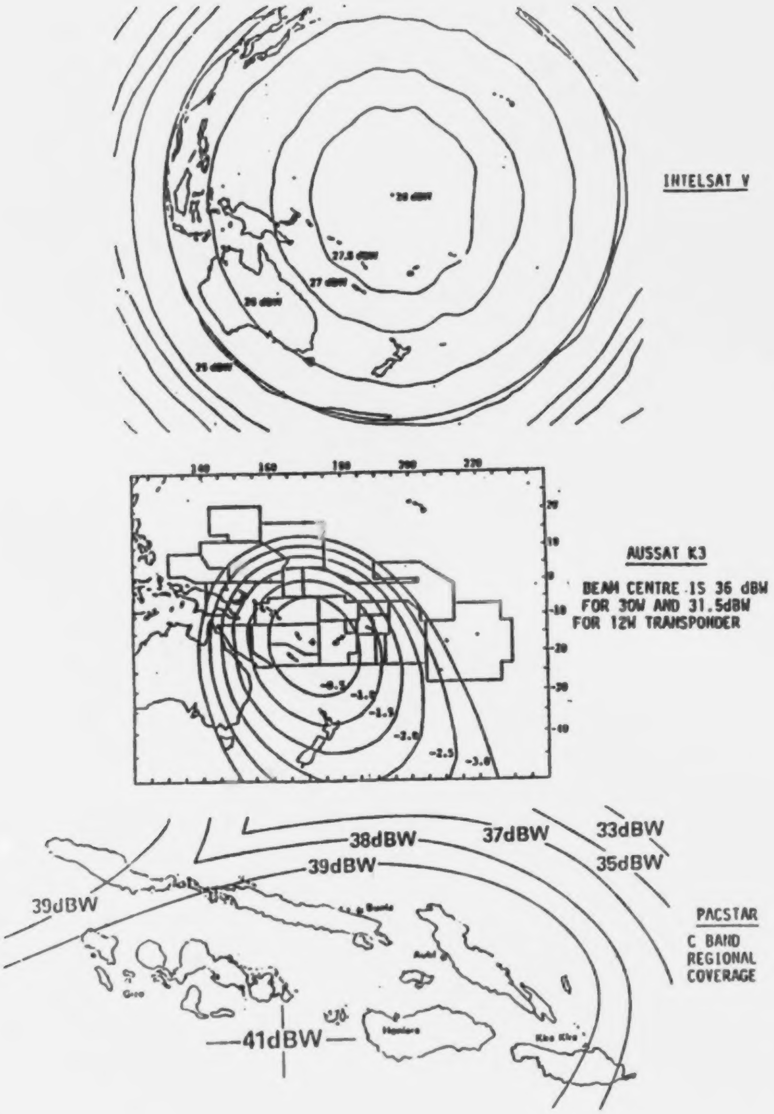
In response to requests from the satellite network interests, a "user" type traffic plan is also being prepared showing the volume and nature of present and likely future traffic flows within and between the countries of the region.

This presentation will differ from the "user" type plans previously prepared in that it will attempt to incorporate projections of national, regional and international traffic flows for the twelve South Pacific countries and will also provide some estimates of non speech traffic densities and directions of flow.

TABLE A - COST COMPARISON FOR MODEL NETWORK

STATION	MAIN CAPITAL COSTS IN US$				SPACE SEGMENT HIRE CHARGES IN US$		
	NO. OF TRUNKS	NETWORK			NETWORK		
		INTELSAT	AUSSAT	PACSTAR	INTESAT	AUSSAT	PACSTAR
CAPITAL CITY	52	506,000 (156,000)*	480,000	365,650	88,400	174,000	43,300
ISLAND A	18	94,000	180,000	104,200	30,600	60,231	18,780
ISLAND B	7	61,000	110,000	54,700	11,900	23,423	7,292
ISLAND C	17	91,000	180,000	99,700	28,900	56,885	17,708
ISLAND D	7	61,000	110,000	54,700	11,900	23,423	7,292
ISLAND E	3	49,000	80,000	36,700	5,100	10,038	3,130
TOTALS	52	862,000 (512,000)*	1,140,000	715,650	176,800	348,000	97,464

* IF EXISTING EARTH STATION IS USED


28 dBW
27.5 dBW
27 dBW
26 dBW
25 dBW
140
160
180
200
220
20
10
0
-10
-20
-30
-40
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
38dBW
37dBW
33dBW
39dBW
35dBW
39dBW
41dBW
Gizo
Auki
Honiara
Kira Kira

INTELSAT V

AUSSAT K3

BEAM CENTRE IS 36 dBW
FOR 30W AND 31.5dBW
FOR 12W TRANSPONDER

PACSTAR

C BAND
REGIONAL
COVERAGE

Figure 1: Coverage Contours for the South Pacific

Tuesday, January 20

Morning Plenary

Governmental and Public Users

Lee, Ja-Hon, Member of Parliament
Republic of Korea

Notes

"Policies of the MPT of Japan Towards the Advanced Information Society"

Minoru Shioya, Director General,
Communications Policy Bureau, Ministry of Posts &
Telecommunications, Japan

Notes

"User-Driven Services: Who Plays, Who Pays, and Who Calls the Tune"

Diana Lady Dougan, Coordinator
International Communications Policy
U.S. Department of State

Notes

CONCURRENT SESSIONS

SESSION 1
Public & Private Networks

USING PUBLIC DATA NETWORKS TO ENHANCE THE FUNCTIONALITY OF PRIVATE NETWORKS

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Abstract

Until recently, the users of private data networks had only the option of selecting network products and putting together their own systems. Today, there is an emerging trend where the user may select the optimal mix of private network components and services from a public data network provider. This paper concerns what public network service providers are doing to insure the orderly transition from a public network solution towards a customized network for each client.

THE REQUIREMENTS

The requirements of private network operators have frequently been to provide cost-effective solutions to data communication problems, while at the same time providing for other requirements such as security or very high data rates. Some requirements were better suited to private network solutions, while other requirements were a match for using a Public Data Network.

GROWTH TO MATURE COMPLEX REQUIREMENTS

In order to build a solution that can satisfy a complex requirement, the Data Communications Manager must have a wide ranging set of components available that can be arranged in rather flexible configurations. In the past, such a wide range of choices were available to those data communications managers who could afford to build private networks. The paper discusses how to start with a public network and migrate along a path that is cost-optimal or performance-optimal. The "Triad" of public network services is discussed as a point of reference, and is often the best starting point for network evolution.

It has been the goal of many of the public data network suppliers to offer the data communication manager the broad choices and flexible arrangements needed to meet a complex requirement without the need to start with a private data network. Components of a network usually include some form of access arrangement for terminals and for host computer devices, transport of data arrangements between access arrangements, network management equipment, and facilities in which to locate the required equipment. The "triad" is a versatile graphic for demonstrating how the major parts of the architecture work together. Integrated system design means that all components work in concert to meet our communications challenges. To this network architecture, the manager must add personnel and the training required for the personnel if the network is operated as a private system. This architecture is a key common factor in all packet networks, public and private.

There is an increased need for worldwide communications. More and more organizations depend on suppliers, customers and partners outside their native borders. Geographical limitations disappear in the face of worldwide instantaneous communications requirements. The interconnections of the public data networks over the past decade have helped remove some of the complications normally associated with international communications, spanning oceans, and multiple time zones. A later section discusses international connections in greater detail.

ACCESS CHOICES

The access layer connects terminals and hosts to the switching layer, concentrates signals to minimize the number of communications times, and converts "native mode" protocol to X.25 protocol.

The different physical characteristics of terminals are accommodated because some terminals use asynchronous communications, others use synchronous. Some have printers, some have only keyboards and displays. Functions to handle different terminals first evolved in the host computer system and moved outward into the networks and terminal concentrators and controllers. In today's packet network architecture, the terminal handler is built into the access layer.

Public networks offer a variety of access choices ranging from individual asynchronous public dial-in ports to access for synchronous cluster controllers. The international standard for synchronous concentration has been X.25 but many networks have accommodated the popular vendor-specific communications protocols such as IBM SDLC. The popular "native mode" protocols are translated to X.25 in a device known as a Packet Assembler and Disassembler (PAD).

The three most popular types of access on public data networks are: asynchronous, X.25 (synchronous), and SDLC (synchronous). Other high-speed batch protocols are supported by a number of networks. These protocols include protocols using binary synchronous communication (BSC). In many cases, however, the "native mode" protocols are first converted to X.25 as a base layer for the communication. The public network then conveys the data through the various interconnected public networks in conformance with the X.25 formats.

Increasingly, computer vendors and terminal system vendors are enhancing their products to communicate using X.25.

There are hundreds of vendors with these PAD protocol converters certified to operate on public data networks. Many public networks now help cost- optimize the access function by providing the customer premises PAD as part of their service offering. The PAD can be supported as an extension of the public network's management service.

One of the first steps that the data communications manager takes to migrate along the public network to private network path is to consider the purchase of a PAD that connects to the public network using X.25 protocol. A PAD can be used in an end-to-end configuration. Eventually, the access layer function will be integrated into terminal equipment such as personal computers. Already there are PC board vendors with PAD products that comprise hardware and software. Increasingly, as the PC becomes the end user's workstation, X.25 will become the dominant communications protocol.

The decision to migrate from a standard PDN public access service to a customer-purchased concentrator with an X.25 access will require some analysis of the specific network service offerings and price schedules. For example, on Telenet in the United States, the asynchronous choices are:

1) use public dial access centers, or

2) obtain a dedicated access for a single asynchronous terminal, or

3) obtain an X.25 dedicated access and rent or purchase a PAD to support several asynchronous terminals simultaneously.

Telenet charges a per-minute fee to use public dial access. There is a flat, fixed-fee in lieu of the per-minute connect charge for a single asynchronous dedicated access. A PAD on a synchronous X.25 dedicated access for several terminals is more costeffective than several separate asynchronous dedicated access facilities.

SWITCHING LAYER

The purpose of the switching layer is to route traffic to its proper destination. The technology enables the switch to select the best route for the call and route around failed or busy components.

TRANSPORT CHOICES

Public Data Networks structure their rates according to duration charges and volume-sensitive charges.

Users of Public Data Networks know that the more the traffic patterns are diverse and distributed, the easier it is to cost justify the use of a public network. Eventually, a user of a public data network finds that some specific data routes develop higher volumes of traffic. These routes may tend to cost-justify leased circuits over volume-sensitive service. Rather than turn their customers away, some public data network vendors have augmented the pure volume-sensitive packet switching service with a hybrid approach. This hybrid approach includes a mix of the volume-sensitive service and the fixed-price private facilities tailored to the customer's requirement. The customer may wish to have part of the switching layer dedicated to them. The customer may then install their own dedicated circuit between two switches located at different premises.

The hybrid concept can work equally well in the international marketplace. Many countries offer Asynchronous or X.25 Service, or private leased circuits that can carry private traffic.

Charges for international connections are normally billed by duration and volume. These rates are typically several times the rates for domestic calls. But what happens where the charges for duration or volume exceed the price of a lease line?

For example, perhaps traffic between the United States and Malaysia has grown to the extent where a leased circuit between the customers' premises in Kuala Lumpur and the customers' premises in Denver, Colorado is cost justified. The solution which includes public data networking between three countries and the leased circuit between two high traffic center pairs is one that the data communications manager once had to plan and implement in a multiple vendor environment. This has changed. The public network supplier, working with the customer on one side and the local administration in another country, arranges for the complete solution. In this case, the customer's requirement was cost containment. It could have been reduction in response time or any other variable parameter.

Even with this international hybrid network, the customer still has the ability to switch traffic between end points because all of the remote end points have recognized international address according to the CCITT X.121 numbering plan. The switch located at the customer premises is dedicated to the customer. Fixed monthly charges apply to the United States/Hong Kong route. Traffic sensitive rates apply only to the switching between the United States, Australia and Canada. The reason that the hybrid is shown based in the United States is only because it is currently a service offering by Telenet and other U.S. carriers as opposed to only a possibility.

There has been rapid growth in the use of T-1 transmission, at least in the United States. T-1 is a wide bandwidth transmission facility. The capacity of T-1 is 1.5 million bits of data per second. In the service providers' race to compete for business, the carriers are moving simultaneously towards the provision of more value-added services and more commodity-oriented, large capacity services. T-1 is an example of the latter. A corporation can normally justify the acquisition of T-1 multiplexer equipment and the transmission services due to cost reductions in long distance voice. How then to accommodate data when a T-1 network backbone is justified and installed.

The locations of the T-1 multiplexers are usually the best choice for locating the data switches. The data communications manager benefits through the use of both the private T-1 network and the integration of public data networking.

FACILITIES CHOICES

The customer may still not be totally satisfied with a solution. There are hidden additional costs. If the location of the dedicated equipment at the customer premises necessitates additional highly skilled technical staff at the customer premises, costs increase. To reduce this worry and risk for the data communications manager, carriers are increasingly willing and able to locate the customer's dedicated equipment in the carrier's facility. The equipment that may be purchased by the customer can be housed in the carrier's central office. Power, cooling, and maintenance are provided under the arrangement. This usually helps the customer further reduce costs, and at the same time can increase the availability of the communications.

MANAGEMENT CONTROL

There are many elements of management control. The public data networks have developed their own tools to manage networks and report on the details of what is happening within the network. These tools are highly dependent on computers. Security has been the major obstacle in the past that prevented the public data network from extending their own tools to the data communications manager. Advances in network and computer security continue. Advances in computer systems' price performance continue. The beneficiary is the data communications manager who may now have access to many of the professional network management tools used by the public data networks.

Network Management Elements include:

- definition of the topology (building software modules and tables),
- loading the equipment with these tables and software,
- generation, capture, and processing of call record data,
- generation, capture, and processing of equipment statistical data,
- generation and reporting of network alarms,
- the monitoring of alarms requiring urgent action, and
- diagnostic capabilities.

The introduction of professional network management tools delivered from the public data network management center available for use by the data communication, addresses a major network management control problem for the network manager. This greatly expands the realm of solutions to the data communications manager.

NETWORK TOPOLOGY CHANGES

The definition of the private sub-network is ultimately performed by the operations staff of the public data network, but the process of communicating between the data communications manager and the network table building staff has improved considerably. Forms on an electronic mail package can now be used. These forms prompt the manager with the exact same questions to be answered by the staff at the PDN network control center when they build tables for the network topology. This ensures a high degree of accuracy and speed. The electronic message is sent to the table building staff, and the tables are constructed and made ready for loading. In a packet switching network, the procedures exist to force the reloading of a switch at any time. There are usually procedures that call for network changes to be made in the early morning on weekends to minimize inconvenience to users. Increasingly, the ability to dynamically change software tables without reloading switch software has been introduced to public data networks.

Once the network topology is defined and changed, the process of loading the network components become automatic. Computers basically take over because the switches automatically request a load as part of their sequence upon from turning on the power.

The request goes to a designated network control center processor. This function was centralized in the earlier days of public data networking. High performance personal computers can now perform the load function as locally attached, fast reload systems for the data switches. This reduces both the traffic load on the network transmission lines and the work load on the network management center computers. The results of a load request are sent to the network management center.

TRAFFIC ACCOUNTING

As in voice communications services, the accounting for traffic on a data network is an essential function. In the public data network, the customer is identified as the party who receives an invoice from the service provider. The data communications manager may have the additional requirement for departmental billing.

The interesting problem in the past was that the public data network deployed its billing system to generate invoices based on the billable use of the network. The billing system was not sensitive to the local traffic on a switch placed at a customer premises that was used exclusively for the customer's local traffic.

The capability of collecting the call records for the local traffic and reporting it to the data communications manager as information rather than an invoice was eventually released to the data communication manager. This provided the data communications manager with the tools needed to operate the private subnetwork as a corporate resource including the ability to allocate costs to departmental users. The traffic can be identified as belonging to either the originating port on the private subnetwork, the destination port, or to a Network User Identification (NUI).

THE NETWORK STATISTICS

Every network manager is going to be asked questions about the network performance. How much capacity is being used on the communication lines and in the switches themselves? Built into a state-of-the-art switch is the capture of statistical data. Parameters such as buffer utilization are as important in a data switch as Central Processor Unit (CPU) utilization. To assist the statistician, the switches are programmed to measure their own utilization during regular intervals. The statistical data is put into a packet at the end of the time interval and sent to the Network Control Center. This is another professional management tool that was previously available only to the public data network planners and designers. This information can be collected for the private network switches and processed daily at the Network Control Center. The finished reports can be provided each day to the data communications manager.

NETWORK ALARMS

Without real-time alarm reports, any component of the network could suffer an outage and the data communications manager would not know about this outage until the user community began calling to complain. The purpose of alarm is to use the other functioning components to report on their failing or failed companion components at electronic speeds. The receipt of alarms at the Network Control Center permits the operations staff to be a step ahead of the network users. When they do call, the operations staff can report that they know about the problem and a resolution is already underway. Alarms about failing, but not yet failed components, permit steps to be taken to avoid a failure. It is far better to be able to anticipate the problems and avoid the network user inconvenience before it occurs.

Alarms for the private subnetwork can be received at the public data network control center, and a copy of the alarm produced and directed to a network address designated by the data communications manager. In this manner, the data communications manager has the opportunity to be fully informed of a critical or pending critical situation before the network users have detected a problem.

MONITORING SERVICE

The designers of data switching systems have created many levels of alarms. All are important but some require urgent response while others allow some time to plan for a corrective action. For example, if a circuit outage occurs and no alternative exists, that could be urgent.

If, on the otherhand, a redundant hardware component has just switched into use, the plan to replace the failed primary component can be calmly started.

The public data network staff have audible alarms and color monitors that highlight events that are critical and require immediate action. As a service to customers with private subnetworks, the circuits that comprise a private subnetwork can be monitored on the NCC reaction monitor.

The data communications manager may designate instructions to be followed should an alarm occur on a monitored circuit.

NETWORK DIAGNOSTICS

One of the most powerful tools available to the public data network staff now extended to the corporate data communications manager is a diagnostics tool. Diagnostics used to troubleshoot problems are programmed into the network components.

The diagnostics permit the operator to display the status of many parameters, to reset some parameters or to cause loopbacks and backup to occur.

The data communications manager can access the same powerful diagnostic tools on a network control center computer. The access to the tool is controlled and the software allows access only to the network components that belong to the particular subnetwork.

INTERCONNECTIONS

There are several public networks in the United States. Access centers on these networks are located throughout the country wherever demand warrants. Nearly the entire business communications population is a local dial-in call to one of these access centers. But the range of access for public data networks is far greater when international access centers are considered. The international access centers with connections to the Continental United States as of October, 1986 are listed in the following table.

INTERNATIONAL ACCESS LOCATIONS

Antigua
Argentina*
Australia*
Austria
Bahamas
Bahrain
Barbados
Belgium*
Bermuda
Brazil*
Canada*
Cayman Islands
Chile*
China, PR
Colombia
Costa Rica
Curacao
Denmark
Dominican Republic
Egypt
Finland
France*
French Antilles
French Guyana
French Polynesia
Gabon
Germany, F.R.
Greece
Guam
Guatemala
Honduras
Hong Kong*
Hungary
Iceland
Indonesia
Iraq
Ireland
Israel
Italy
Ivory Coast
Jamaica
Japan*
Jordan
Korea
Kuwait
Luxembourg
Malaysia*
Mexico*
Netherlands
New Zealand
Norway*
Panama
Peru
Philippines
Portugal
Puerto Rico
Qatar
Reunion Islands
Saudi Arabia
Singapore
South Africa
Spain*
Sudan
Suriname
Sweden*
Switzerland*
Taiwan
Thailand
Trinidad & Tobago*
United Arab Emirates
United Kingdom*
USA--Alaska*
USA--Conus*
USA--Hawaii*
Virgin Islands

*Denotes that public networking in the country supports the X.25 synchronous protocol. All others are asynchronous access only.

Each of these countries offer at least asynchronous ports. The table also indicates which countries are operating X.25 synchronous service.

A study conducted by the American Management Association reported that during 1986 more end users of remote computing gained access from a personal computer to their applications than from standard, non-intelligent asynchronous terminals. Several reasons for the record breaking use of personal computers by remote end users were cited. One reason is that personal computers, which do not yet out-number asynchronous terminals, are conducive to a shared user environment. The milestone set by personal computer end users signals another benefit to the data communications manager. The personal computer can be configured to operate as an emulator of either asynchronous, X.25, or SDLC protocols. Particularly in X.25 mode, the personal computer allows the manager to reduce connect time charges considerably through the use of higher speed access. The numbers of and functionality of X.25 circuit boards for personal computers is growing. Some of these boards support speeds up to 4800 bps for dial-in and up to 64 thousand bps per second for dedicated X.25 links. As of last count, there were eleven vendors who were promoting these products extensively in international publications. Prices were as low as $795 U.S. for a single card.

The use of higher-speed X.25 benefits the data communications manager by reducing connect-time charges. Moreover, the terminal user can do more in less time.

NETWORK ADDRESSING

Considerable effort was put into a plan for private network addressing by the CCITT Study Group 7. In order for private networks to benefit from anywhere in the world, private networks should be constructed using recognized existing public data network addressing.

An example of network addressing for a private network might include a collection of blocks of addresses from within the address universe of a public data network. This example shows a private network with three geographic regions. The regions each relate to a gateway on the public data network and take their area codes from the public data network's geographic regions.

The private network can now be built using an addressing hierarchy. Moreover, the private network can be addressed from public networks worldwide.

SUMMARY

Data communications managers who have had the need to meet requirements not completely satisfied by the use of public data networks in the past should take another look at public data networks today. New flexibility exists. Many ways to combine the best mix of public and private network characteristics are now available. Starting with the public packeting service is just a beginning. There are virtually no limits to growth.

INTRODUCTION OF DIGITAL LOOP CARRIERS IN PACIFIC BASIN COUNTRIES

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ABSTRACT

Digital loop carriers are being introduced in countries in the Pacific Basin; these systems allow telecommunications administrations to provide a cost-effective way of modernizing their loop plants. This paper discusses general features of digital loop carrier systems, their applications, and illustrates the steps an administration can take to evaluate the applicability of digital carrier systems in their networks.

1. *INTRODUCTION*

Various modernization programs are being carried out in the telecommunications networks of many countries. The objectives of these programs are to provide more ubiquitous telephone service for the general population, to introduce new digital services, and to prepare the telecommunications networks for ISDN (integrated services digital network).

The modernization of the loop plant, which currently consists mainly of metallic cable pairs, is an important element of these programs. Due to the limited bandwidth available, especially for loops of considerable length, metallic pairs can accommodate only a limited number of services.

In this paper the role of digital carrier systems in the evolution of telecommunications networks will be discussed. These systems are deployed widely in the United States, and are being introduced in countries in the Pacific Basin.

The next section discusses the different factors that are shaping the evolution of the loop plant. Section 3 gives an overview of AT&T's SLC® 96 carrier system, a product that accounts for the majority of lines served on digital carrier systems. Section 4 discusses the applications for digital loop carrier systems; many of these applications are important for Pacific Basin countries. Section 5 illustrates the planning process that should be undertaken in evaluating whether digital carriers constitute an economically practical alternative for the loop plant.

2. *TRENDS IN THE EVOLUTION OF THE LOOP PLANT*

The evolution of the loop plant is driven by many factors. Among these factors are: economics, new services, and technology.

Investment in a telecommunications network can be broken into three broad categories: the loop plant, the switches located in central offices, and trunks for interoffice transmission. Since the loop plant typically contains facilities dedicated to individual customers, it usually represents a major fraction of the total expenditures, in many cases exceeding 50% of the capital invested. Consequently, it is important to minimize the investment in the loop plant, while ensuring that facilities put in today continue to be useful for services required many years in the future.

A second factor is the obsolescence of the traditional copper loop plant. In the past, telephone services consisted mostly of voice and sometimes voiceband data services. The copper wire pair was sufficient to provide access to the central office for these services. However, customers are now demanding both digital and wideband services that the copper wire pair would have difficulty accommodating. In the United States, for example, many operating companies are digitalizing the loop plant, in some cases providing wideband digital paths by lightwave systems on optical fiber. This activity, together with modernization programs for switches and interoffice transmission, makes the provision of these new services possible.

Also, advances in technology and manufacturing techniques have made it economical in many instances to incorporate electronics and fiber optics in the loop plant.

Digital loop carrier systems, of which the AT&T SLC® 96 Carrier System is an example, are synergistic with these trends in the evolution of the network. These systems accelerate the digitalization of the loop plant. The use of fiber systems as the transmission medium for carrier systems also help prove in other wideband digital services.

Due to these technological and economical factors, digital loop carriers have been chosen as the service vehicle for about 50% of the growth loops in the United States, with a significant fraction of them fiber systems. For example, in the few years since its introduction, there have been more than 75,000 SLC 96 carrier systems installed in the United States, corresponding to about 7 million lines.

3. *THE SLC® 96 CARRIER SYSTEM*

The basic SLC® 96 carrier system is a digital system that combines 96 voice channels onto four 24-channel digroups for transmission (see Fig. 1). A remote terminal (RT) is placed at a location, often in the outside plant, close to the end customers, thus reducing the access length on wire pairs. The remote terminal is connected, via T1 lines or lightwave systems, to the central office terminal (COT) which performs functions similar to those of the RT.

In addition to regular message services, different channel units have been developed for the SLC 96 system to provide many additional services, including:

- Multiparty message services,
- Coin telephone services,
- Voice frequency special services,
- Digital dataport services.

For optical transmission, electrical line interface units can be replaced with optical units for direct interface to fiber. In many instances, lightwave multiplexers designed for the loop plant are used with SLC carrier systems to exploit the wider bandwidth offered by lightwave systems.

In the several years since it had been first deployed, the SLC 96 system has proven to be a reliable and easy-to-maintain system. These features are achieved by the following:

- Electronics placed in the outside plant is hardened for the diverse environmental conditions.
- Various remote terminal enclosures have been designed to protect the equipment placed in the outside plant.
- Protection switching is provided in case of line failures.
- A test controller has been developed to isolate quickly, from a central location, problems encountered by subscribers served by the system.

SLC 96 systems are synergistic with other AT&T network products, including digital switches and operations systems, so telephone administrations can have maximum flexibility and efficiency in their design of total networks.

4. *APPLICATIONS FOR DIGITAL LOOP CARRIERS*

There are many factors that would make digital loop carrier systems an attractive alternative to other solutions to the network evolution problem. Often it is a combination of several considerations that makes the digital carrier system an attractive option. Several major applications for digital carriers are listed below.

Small Switch Replacement.

In suburban and rural areas, small communities are often served by small switches (sometimes known as community dial offices, or CDOs). When the capacity of such a switch exhausts, it may be more economical to provision growth lines with digital carrier systems for access to a larger switch in a neighboring central office.

Remote Access to Digital Switches.

Most digital switches have associated remote vehicles that can help subscribers located at a great distance from the host switch, access the host switch economically. Under certain circumstances, for instance, when the number of growth lines is too small for a remote switching module, digital carriers can provide digital access to switches in a more cost-effective manner.

Provisioning of Special Services.

Since special service circuits (both voice and data) usually require conditioning of the copper cable, they are generally labor-intensive and expensive to provision. As discussed above, many channel units have been developed for the SLC® 96 carrier system so the provisioning of the corresponding special service circuits requires only plug-in changes on the system.

Digitalization of The Loop Plant.

To accommodate present and future digital services, and to improve the cost-effectiveness of access to digital switches, the general trend is to install digital facilities, including lightwave systems, in the loop plant. Digital carrier systems can be deployed in conjunction with such a strategy.

Facility Relief Applications.

Facility relief accounts for a significant portion of digital carrier applications. As the number of subscribers grow in the areas served by a particular feeder route, additional facilities must be provided to accommodate the new demands. This addition may be the placing of new copper cables along the feeder route. Along routes where the capacity of the support structure (underground conduits, for instance) has exhausted, new structures must be built, resulting in high expenditures. Since digital carrier terminals require only a few T1 lines to provide transmission facilities for many customers, their use may postpone or obviate the need for new cables and structures, thus providing a more economical solution.

5. *PLANNING*

The deployment of digital loop carriers in a network requires careful planning that takes many factors into account. In this section the planning of SLC® 96 systems for pair gain applications will be described through an example. The planning process consists of the following steps: data gathering, SLC carrier feasibility study, determination of remote terminal locations, and the determination of deployment schedules.

The plan was developed with the aid of a loop planning tool developed at AT&T Bell Laboratories.

The data gathering process collects the relevant information about a particular feeder route and its distribution areas. For this example, the data is displayed in Fig. 2. The data consists of: current and projected demands for the feeder sections over the study period (10 years), existing cables and structures and their corresponding capacities, and various economic factors including the discount rate. Also, cost data associated with placing new cables and new structures is required for the study.

In the second step, a cable solution is obtained by choosing an optimal solution among the options made available to the planning tool. An economic profile for the different sections of the feeder route can therefore be established, with sections closer to the central office typically costing less on a per line basis. The planning tool also generates a corresponding economic profile for the sections along the feeder route when SLC 96 systems are deployed to meet the increases in demand. The two economic profiles for the feeder route then can be compared with each other, as shown in Fig. 3. It is clear from the figure that beyond a certain point in this example, SLC 96 systems would offer a more cost-effective solution.

The third step in the planning process determines the actual locations of remote terminals within the feasibility region. This recognizes that better solutions can be obtained by limiting the deployment of SLC carrier systems to a few sections instead of at every section. The optimal choices for this example are shown in Fig. 4. Since the planning tool considers demands over time, a deployment plan for SLC systems is also generated in the process.

Similar approaches can be taken to evaluate the economics of using SLC 96 carrier systems in other applications. It should be noted, however, that the calculations above were limited to a comparison of capital expenditures. Many unquantified benefits of SLC 96 carrier systems - for instance, its flexibility, better performance, lower maintenance costs, and ability to accommodate special services - were not taken into account.

6. *CONCLUSION*

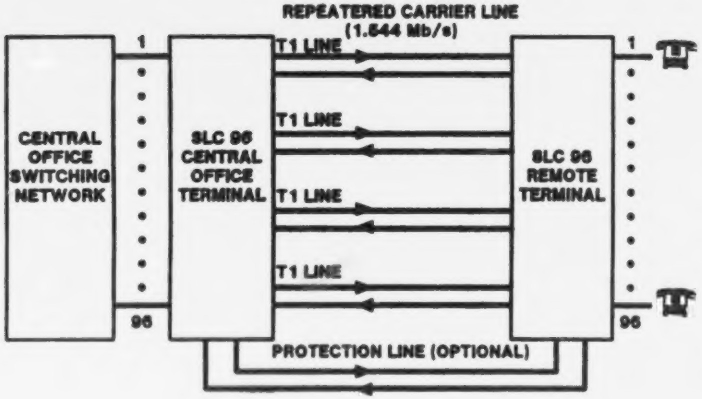
Digital carrier systems constitute a major element in the evolution of the loop plant in the United States. Their deployment is an integral part in the transition of the telecommunications network towards ISDN.

Telecommunications administrations in many countries, including those in the Pacific Basin, have begun to evaluate the benefits of digital carrier systems in their network. Many have begun to deploy digital carrier systems, for example the AT&T SLC® 96 carrier system, on a limited scale to better understand the issues involved as well as to gain some practical experience.

Interactions with telecommunications administrations outside the United States have confirmed that the needs of different countries may well be different from those of the US. AT&T is working with many administrations to define and develop digital loop carrier products that will figure prominently in evolution plans of these administrations.

Fig. 1

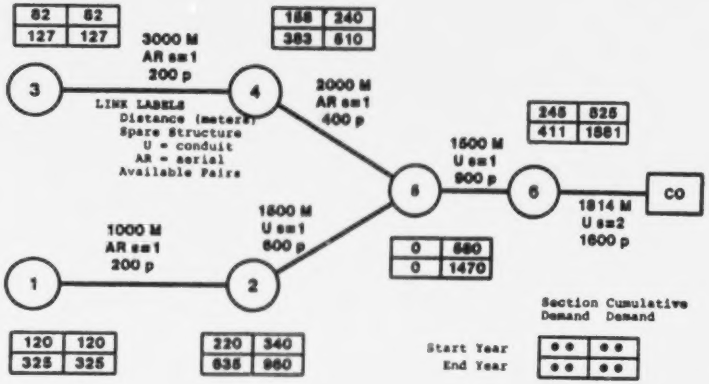
SLC® 96 SYSTEM LAYOUT



REPEATERED CARRIER LINE
(1.544 Mb/s)
CENTRAL OFFICE SWITCHING NETWORK
1
96
SLC 96 CENTRAL OFFICE TERMINAL
T1 LINE
T1 LINE
T1 LINE
T1 LINE
SLC 96 REMOTE TERMINAL
1
96
PROTECTION LINE (OPTIONAL)

Fig. 2

INPUT DATA



82 | 82
127 | 127
3000 M
AR s=1
200 p
158 | 240
383 | 610
3
4
LINK LABELS
Distance (meters)
Spare Structure
U = conduit
AR = aerial
Available Pairs
2000 M
AR s=1
400 p
245 | 825
411 | 1881
1500 M
U s=1
900 p
5
6
CO
1814 M
U s=2
1600 p
1000 M
AR s=1
200 p
1500 M
U s=1
600 p
0 | 580
0 | 1470
1
2
120 | 120
325 | 325
220 | 340
635 | 960
Section Demand
Cumulative Demand
Start Year
End Year
●● | ●●
●● | ●●

259

Fig. 3

SLC® VS CABLE
SLC Fill 90%; Cable Fill 60%

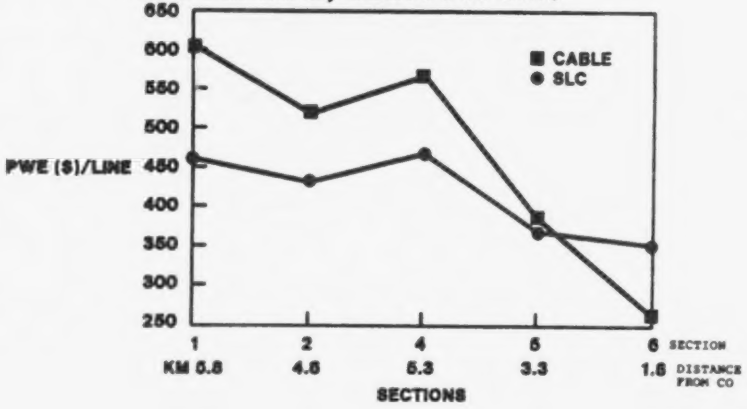
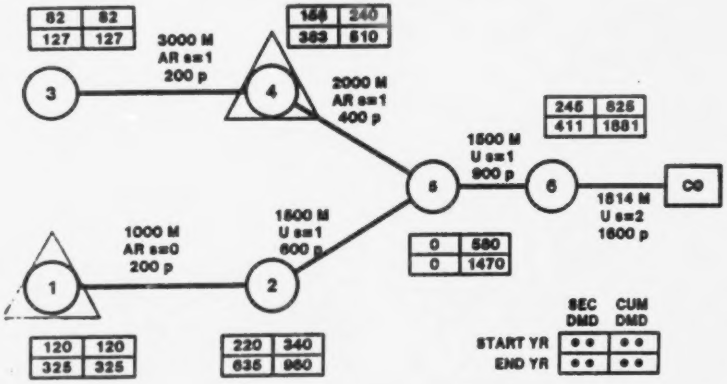


Fig. 4

RT SITE SELECTION



82 | 82
127 | 127
3000 M
AR s=1
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383 | 610
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2000 M
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245 | 825
411 | 1881
1500 M
U s=1
900 p
5
6
CO
1814 M
U s=2
1600 p
1000 M
AR s=0
200 p
1500 M
U s=1
600 p
0 | 580
0 | 1470
1
2
120 | 120
325 | 325
220 | 340
635 | 960
SEC DMD
CUM DMD
START YR
END YR
●● | ●●
●● | ●●

238A

PRIVATE SATELLITE NETWORKS FOR BUSINESS COMMUNICATIONS

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Scientific-Atlanta, Inc.
Atlanta, Georgia

1. Abstract

An increasing number of businesses are using private satellite networks for secure transmission of video, audio, data and text. These practical communications networks open new opportunities for business management and operation. A private network system for business communications should provide a high level of security, a rugged transmission format, optimum usage of transponder space, high-quality video and audio signals, and economical implementation. Scientific-Atlanta's ECHELON system, which utilizes the B-MAC format, satisfies these requirements. Applications for the ECHELON system are wide-ranging, and new areas of growth exist in additional businesses which are currently using more costly, less effective communications systems.

2. Private Satellite Networks and Business Communications

Imagine the president of an insurance company holding a live motivational session with sales people simultaneously at all sales offices throughout the country. Consider the chairman of a major automotive company introducing new model cars to all dealers across the nation -- all live and all secure against eavesdropping by the competition.

Now, corporations and others need no longer just imagine the convenience of live, private video, audio and data communications. As a result of the technological developments in the field of satellite communications, businesses now have a practical, efficient means of operating their own private communications networks.

Since 1982 there has been steady growth in permanently installed or dedicated private business television networks. Because satellite communications offers the only practical "last mile" transmission medium medium with the necessary bandwidth for video, private satellite networks have become an attractive option for business communications. The role of video in business communications, which could previously be handled only by mailing videotapes or through personal travel, is emerging as a major factor in the increasing usage of private satellite networks.

Most private satellite networks require secure video, audio and data delivery, with one central uplink or transmitting site, usually at the corporate headquarters or carrier's facility, and geographically disbursed downlinks at various company locations. Such point-to-multipoint networks enable users to satisfy heavy one-way video and data communications needs economically. The type of video programming delivered is most often live productions, which could include pre-produced segments on videotape.

The development of higher powered Ku-band satellites in the late 1970s has made the use of smaller, less expensive Ku-band antennas possible. Transponder space is readily available on many of these newer satellites, and some companies (called network integrators) offer a complete package which includes system design, equipment, installation and satellite time.

Applications for these networks include not only corporate communications, but also training and education, marketing and sales, health care and entertainment, for both domestic and international users.

3. Network Requirements and Characteristics

A private satellite network for business communications should provide a high level of security, a rugged transmission format, optimum use of transponder bandwidth, high-quality signals and economical implementation.

Where networks for business communications are concerned, security is essential -- no company allows competitors to look in the cash register or listen in on conference room planning. An encoder located at the uplink site and decoders at each downlink site are used to provide scrambling of the video and encryption of audio, data and text information to provide complete network security. Because attempts to defeat security have become more sophisticated, a scrambling and encryption technique must be virtually unbreakable to counter these ongoing attempts.

A rugged signal -- one which is tolerant of non-linearities in the transmission channel and degrades gracefully in the presence of noise and interference -- provides a major economic and availability advantage. Such a rugged signal allows reductions in the size of receiving antennas and provides picture and audio availability even under adverse reception conditions.

For a business network to operate at its most efficient level, it should make maximum use of the transponder bandwidth. Existing broadcast transmission formats, such as NTSC and PAL, were developed primarily for compatible color and black-and-white reception and before video transmission via satellite was possible. These composite formats were not designed for FM transmission and do not optimize the use of baseband bandwidth. Private satellite networks can use appropriate new formats combining analog and digital signals that allow the transmission of more information in a given channel while maintaining a more rugged signal.

Private satellite networks require high-quality signal transmission for video, audio and data information. A suitable format will provide this high level of performance while using no more satellite power or bandwidth than conventional satellite transmission formats. Unfortunately, most existing formats have a number of shortcomings, largely due to the frequency-multiplexed nature of the video, audio and synchronization signals. On the other hand, a time multiplexed signal with digital signals in the blanking intervals eliminates the need for the color and audio subcarriers and produces improved signal quality and enhanced features.

In addition to providing a high degree of security, high-quality picture, and a rugged bandwidth efficient format, the transmission format should have an economical implementation. The processing of the format should be realizable with custom integrated circuitry to eliminate groups of standard ICs, thereby reducing the cost of production. The total network cost can also be reduced by combining video, multiple audio, data and text signals on a single satellite transponder.

4. Description of Scientific-Atlanta ECHELON^{tm} System

4.1 B-MAC Format

Scientific-Atlanta's ECHELON system for private satellite networks incorporates the necessary hardware and software to establish uplink and downlink facilities for private networks. The system meets the objections for providing secure, high-quality video, audio, and data with a rugged economical approach. A typical uplink is equipped with a transmit-receive antenna (usually 4.5 to 7 meters in diameter), high-powered amplifiers (HPAs), video exciters, low-noise block converters (LNBs), encoders and a control computer. The downlink antenna ranges from 1.2 to 2.8 meters in diameter. Each downlink is also equipped with an LNB, a satellite receiver and a decoder.

The heart of the ECHELON system, however, is the Scientific-Atlanta B-MAC secure satellite transmission format. This new integrated transmission format is based on use of the multiplexed analog components (MAC) for video with all other information digitized and inserted at baseband in the blanking intervals. The development of B-MAC was based on the need to optimize satellite delivery and, indeed, the format is capable of simultaneous delivery of video, audio, error-corrected data and teletext.

B-MAC replaces existing formats which are based on frequency-division-multiplexed video signals with a highly bandwidth-efficient time-division-multiplexed signal. The system can also be used to deliver secure, accurate digital information, which B-MAC multiplexes into the horizontal and vertical blanking intervals of the television signal.

The fundamental difference between B-MAC and existing transmission formats such as PAL or NTSC is that, instead of frequency multiplexing luminance and chrominance components, B-MAC time multiplexes the components prior to transmission to the satellite. In the B-MAC format, chrominance signals followed by luminance signals are transmitted during one active TV line. Chrominance (R-Y or B-Y) is compressed to 1/3 of its normal time and is transmitted on alternate lines. The luminance signal is compressed to 2/3 its normal time and occupies the remainder of each active line.

A digital data signal is multiplexed at baseband into the horizontal blanking interval. This data stream includes six 204K-bit digital audio or data channels in addition to an error-corrected 9600 baud data channel. When audio is required for any of the six channels, Dolby^R adaptive delta modulation is used for quality and efficiency. The vertical blanking interval is used to transmit digital synchronization information, security and control data, downlink addressing and digital teletext. An example of the complete format is shown in Figure 1. A TV frame is displayed with syncs offset to show the blanking intervals as well as the compressed MAC video.

4.2 Advantages of ECHELON System

The high level of security provided in ECHELON is achieved by hard video scrambling and high-level digital encryption of the other portions of the B-MAC signal. The video is scrambled using Scientific-Atlanta's line translation technique, with control of descrambling determined from the encrypted digital data. Line translation scrambling uses a technique for shifting the starting point of each horizontal line according to a pseudo-random sequence. This pseudo-random sequence is changed every 1/4 second and is transmitted in the encrypted digital signal in the vertical blanking interval. This line translation, or time-base scrambling system, redistributes the picture information in time, yielding a scrambled picture which is totally obscured, yet can be reconstructed in the descrambler to a high-quality picture with no visible or measureable degradation or artifacts relating to the scrambling technique. Figures 2 and 3 show a typical scrambled and subsequently descrambled picture from an actual B-MAC transmission.

All digital information is encrypted using a sophisticated multiple key encryption algorithm. The number of bits in the key and the method for using multiple keys makes unauthorized decryption virtually impossible even with modern high-speed computers. All digital signals also use various forms of forward error correction, concealment and redundancy techniques to minimize susceptibility to noise and interference.

The B-MAC format provides RGB signals to the display producing better color, detail and definition than has previously been possible in video broadcasting. The multiplexed transmission of luminance and chrominance components eliminates chroma/luminance separation problems encountered in NTSC, PAL and SECAM. Thus, there are no color artifacts in the B-MAC picture. Since the two signals are never simultaneously in the transmission channel, non-linear distortions such as differential phase and gain and chroma/-luminance intermodulation do not occur thereby eliminating other picture impairments. Although an RGB display is recommended, standard NTSC or PAL outputs are available on B-MAC decoders.

The elimination of the audio and color subcarriers in the B-MAC format also allows for a more efficient use of the available IF bandwidth as well as a specially designed pre-emphasis and de-emphasis. The B-MAC formatted signal occupies less satellite bandwidth for a given FM deviation than a standard NTSC, PAL or SECAM formated signal. Given a transponder bandwidth which is adequate for a standard TV format, the extra bandwidth available with the B-MAC format can be used to increase the frequency deviation and, hence, the signal-to-noise ratio. In addition, digital information is multiplexed between the analog video, opening up many new possibilities for business television.

Other economical advantages of the B-MAC format include its compatability with FM demodulators used in conventional low-cost satellite receivers and its custom integrated circuit implementation. See Figure 4 for a view of the B-MAC single-board decoder using 10 custom ICs.

4.3 User features

As stated earlier, the B-MAC format offers six high-quality digital audio channels. The excellent audio quality in the B-MAC format for six channels is possible because the Dolby^R delta modulation technique allows PCM quality at 1/3 the PCM data rate. The six channels may be configured as separate channels, as stereo pairs or for surround sound plus spares. These multiple audio channels can be used to provide audio

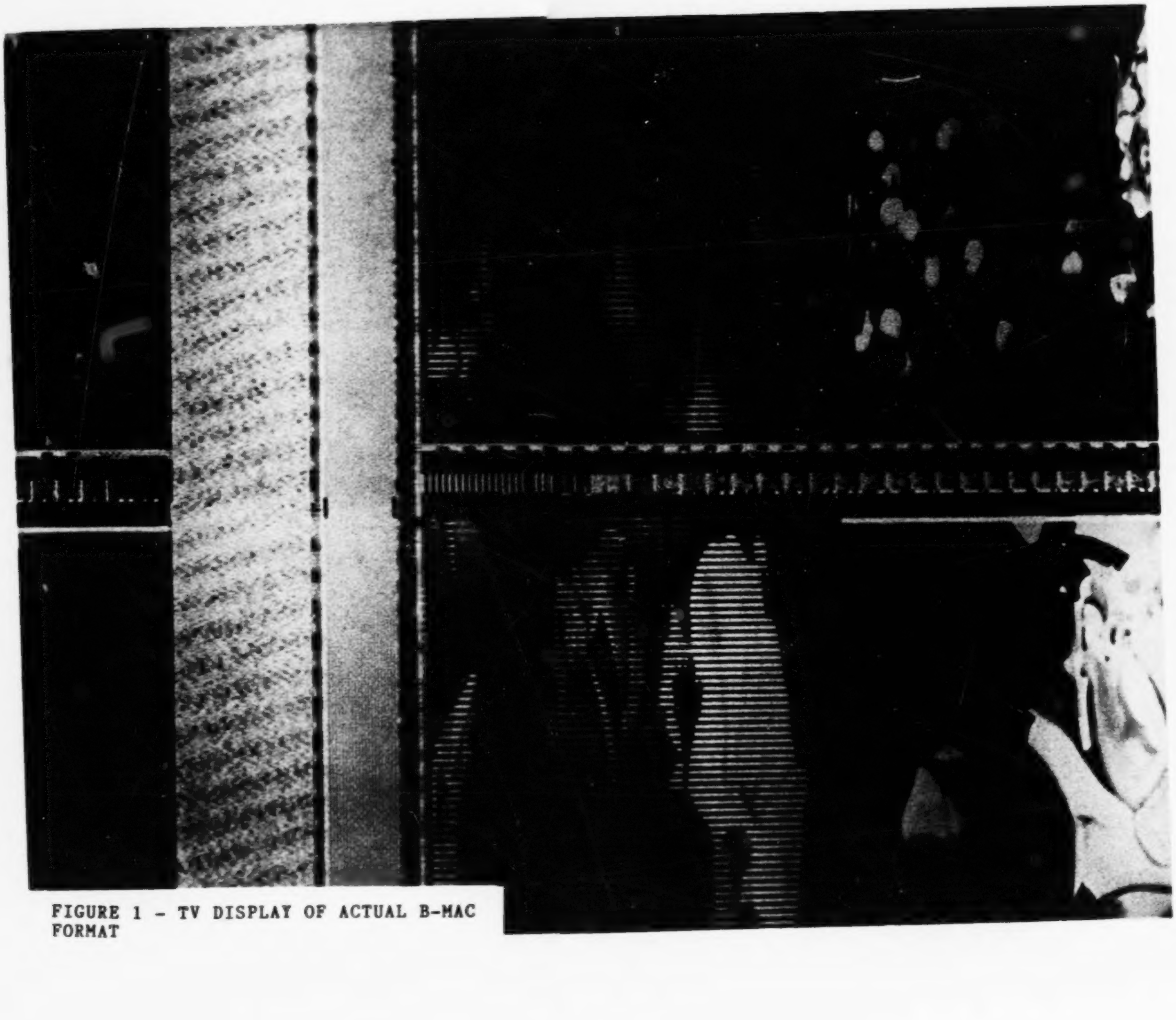

FIGURE 1 - TV DISPLAY OF ACTUAL B-MAC FORMAT

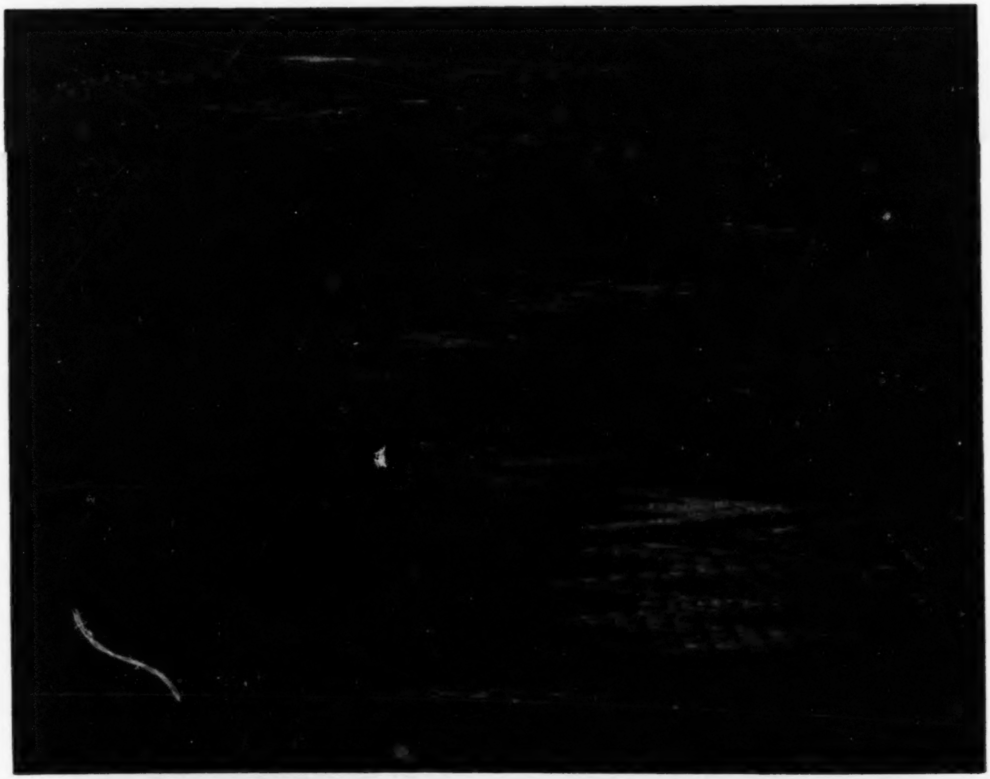

FIGURE 2 - SCRAMBLED PICTURE USING
B-MAC LINE TRANSLATION SCRAMBLING

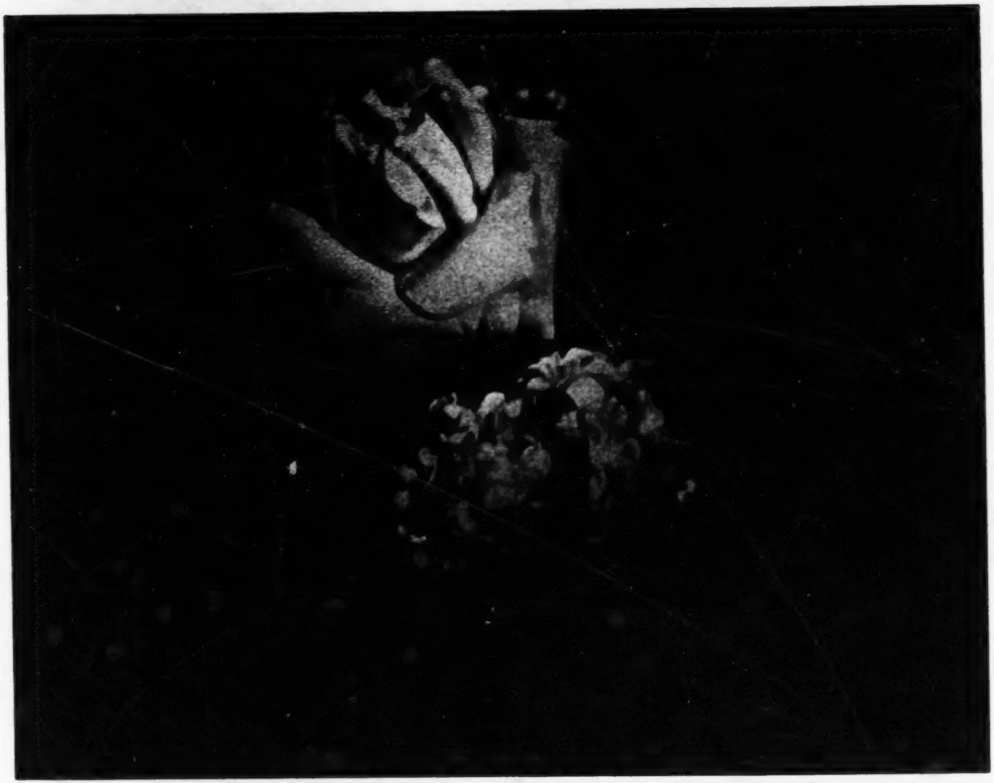

FIGURE 3 - DESCRAMBLED PICTURE OF
SIGNAL SHOWN IN FIGURE 2

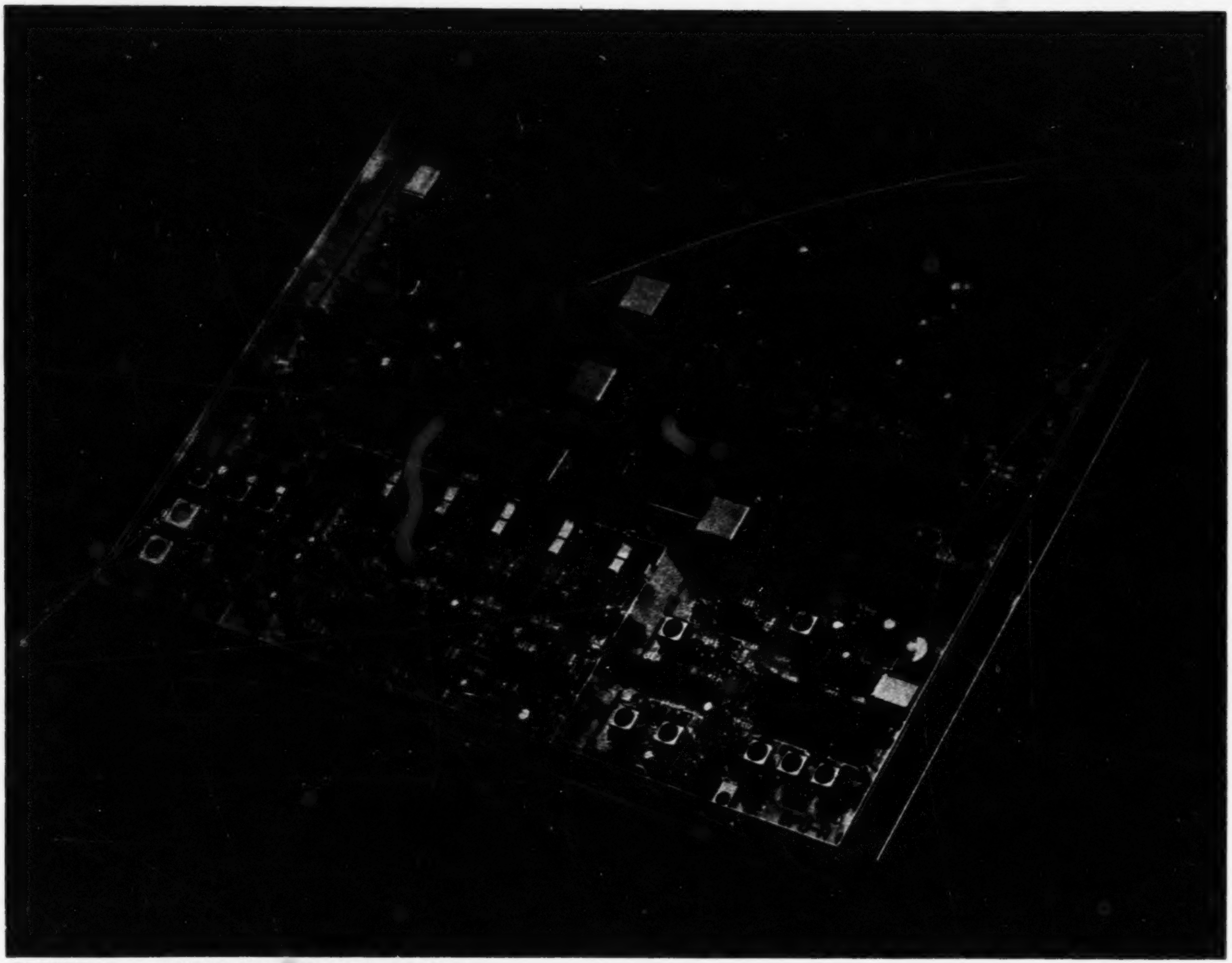

FIGURE 4 - SINGLE CARD B-MAC DECODER

services separate from the audio associated with the video programming, such as multiple language programming or a separate radio service.

Full color teletext is also an integral part of the B-MAC system, with 300 pages (based on 525 line format) of encrypted or clear text available to all users or, on an addressable basis, to any specific user.

An added feature of the system allows any of the six audio channels to be reconfigured into conditional-access data channels. Each audio channel so used adds another 204Kbit of raw data to the utility data channel. An optional data card can be used to provide error-corrected data at the rate of 19.2Kbit.

Because the text information and the video information are independent but transmitted simultaneously in one channel with B-MAC, the opportunity also exists for side-by-side display of text and video without the need for additional transponder space. For example, with two monitors a business might show a speaker on one screen with accompanying graphics on the other. When only one monitor is available, the text information can be superimposed over the video. Other uses for the text services include subtitles, captioning for the deaf, menus and directions, magazines, text data, and general and personal messages.

4.4 Operational features

A network configured with the B-MAC format is extremely flexible because it is addressable from the origination point such that portions of the signal, or even the total signal, may be accessed or denied at each decoder. Video, audio, data and text signals may be received by as many or as few locations as desired. In addition, receiving sites can be addressed individually or in groups.

The addressing technique provides for up to four billion addresses with redundancy for reliable reception. Addressing is at the rate of 1 million/hour. Effectively instant (1/4 second) access is provided to all authorized programs when the user changes channels. A business network can use addressing to provide specific programming to only those individual locations or groups of locations in the network to which the programming applies.

5. Existing ECHELON System Networks

Both directly and through system integrators such as Private Satellite Network (PSN), Satellite Conference Network (SCN), VideoStar and AT&T, many U.S. companies are taking advantage of private satellite network opportunities with the ECHELON system. Federal Express, General Motors, ComputerLand, Merrill Lynch, the New York Racing Association, Holiday Inn, Digital Equipment Corporation, A.L. Williams, Texas Instruments, Eastman Kodak, Hewlett Packard, J.C. Penney, Mutual of New York and the Mayo Clinic are among the users. Internationally, British Telecom, Sky Channel (an Australian hotel network), Club Super Station (a network for private clubs in Australia) and TV Globo in Brazil have also discovered the value of the ECHELON private satellite network.

For example, Federal Express and Eastman Kodak both make use of ECHELON networks for corporate communications. Corporate communications can range anywhere from unveiling new products to distributing details of complex union contracts to personnel departments nationwide. Federal Express has upgraded its existing internal satellite network to include secure addressable video using Scientific-Atlanta's B-MAC. The Kodak network began operation with 60 sites in the U.S. and Canada and is used not only for corporate communications but for training, sales and marketing as well.

A.L. Williams and Associates, an Atlanta-based life insurance company, uses its network primarily for education and training of its 145,000 predominantly part-time employees. The network, probably the largest corporate video network in the world, is also used to broadcast regulatory updates, information on promotional campaigns and details on incentive programs.

More health care institutions are discovering the value of private satellite networks. For example, the Mayo Clinic, which is opening two extensions in Florida and Arizona, is using a two-way ECHELON system to allow doctors at the new facilities to consult with physicians at the Rochester, Minnesota, location. The network provides the added advantage of live broadcast-quality television images of diagnostic procedures and patient examinations. Because the video component B-MAC technology allows expanded bandwidth, resulting in substantial improvement and enhancement of the video resolution, the

Mayo Clinic network will even have the video quality required for video image transmission for radiological purposes.

Another important use for private networks is in the area of marketing and sales. J.C. Penney launched its private network on a trial basis in November 1984, with its ultimate goal to reach buyers at some 160 stores across the country. The network, with 149 store now on line, is used to preview product lines and send additional marketing and sales information to J.C. Penney department stores, and Penney is working to begin broadcasting consumer information and retail training programs to shopping centers nationwide.

ComputerLand Corporation operates the ComputerLand Television Network (CLTV) not only to improve corporate communications and better educate franchisees, but also to enable vendors to communicate directly with ComputerLand franchisees for sales and marketing presentations, sales and service authorization training and new product introductions. The network actually serves as a sales tool in itself -- customers are drawn into the store to have the opportunity to participate in a live broadcast, or at least to view a tape of the broadcast later.

ECHELON customers are finding new entertainment uses for private networks, as well. PROSTAR, a Houston-based supplier of leased satellite communication products and services, is supplying ECHELON products to the New York Racing Association (NYRA) for a satellite network which provides off-track betting parlors with live horse racing simulcasts. Most NYRA downlinks will be in the state of New York, but some 20-30 will be located at casinos in Las Vegas. British Telecom is supplying ECHELON encryption products to Satellite Racing Development Ltd. (SRD), a betting franchise operator thoroughout the U.K. The B-MAC system is used to deliver hard-scrambled video in conjunction with six separately addressed audio channels and a data channel for teletext. This "customized" audio allows SRD to send a common video picture to all its licensee groups while sending local announcers' audio to each licensee.

International use of the ECHELON system is increasing. Brazil's largest television network, TV Globo, purchased ECHELON encryption equipment. The Sky Channel, a private satellite network in Australia, is using an ECHELON network to broadcast specialized television programming to hundreds of hotels throughout the country. Club Super Station, another private Australian network, transmits sports, music and educational programming to private clubs in New South Wales via an ECHELON system. The entire country of Australia, in fact, has standardized on the ECHELON B-MAC format for all its broadcasting applications. The Australia Broadcast Corporation, via the country's new AUSSAT I domestic communications satellite, uses B-MAC for retransmission of television signals to remote areas, in addition to transmission to the outback population's Homestead and Community Broadcast Satellite Service.

6. Future of the ECHELON Private Network Market

While the ECHELON system is fully upgradeable to two-way data, most users are currently utilizing ECHELON networks for one-way video and one-way data. However, as more businesses become aware of the advantages of an ECHELON network the uses for these networks will grow.

Cross-networking, or shared use of dedicated business networks, is becoming a viable application, as more and more businesses acquire their own ECHELON networks. These networks may communicate among themselves for uses ranging from new product introductions to after-sales training. For instance, ComputerLand is interested in interconnection with other companies' private networks (Eastman Kodak or Hewlett Packard, for example) to present information on the customer's site about the products ComputerLand offers. Texas Instruments has already used this idea to broadcast a symposium, and other users will soon follow.

HI-Net Communications, a partnership between subsidiaries of Holiday Inns, Inc., and Communications Satellite Corporation, uses Scientific-Atlanta's ECHELON network for delivery of programming to hotel guests and for videoconferencing services throughout the U.S. The network not only allows HI-Net secure business conferencing but also opens the door to greater use of cross-networking.

International networking is also on the upswing. Several recent developments have made it easier and less expensive for U.S. corporations to include foreign sites in their networks as well as for foreign corporations to include U.S. sites. These developments include: (1) deregulation of U.S. earth stations for international satellite transmission; (2) an increase in the number of regional satellite systems throughout the world; and (3) working agreements among providers in different countries that provide lower costs and ease red tape constraints. Companies which operate on a global basis, with branch offices or subsidiaries throughout the world, will be able to communicate via private satellite networks with all these locations to deliver the latest product, service and industry information.

Finally, the ECHELON B-MAC format offers the potential for extended definition TV (EDTV) -- a development which allows not only improved picture quality through component transmission but also improved resolution. The increased baseband bandwidth available with B-MAC permits improved horizontal resolution. This higher resolution video opens up even more possibilities for ECHELON networks, allowing uses such as detailed technical training, in-depth product demonstrations and even medical consultation. The current Mayo Clinic system employs B-MAC with extended definition. Of course, the carrier-to-noise requirements are greater if an increased bandwidth signal is transmitted.

7. Conclusion

Private satellite networks are quickly evolving into the business communications media of the future. With their lowered costs and increased flexibility, these networks offer the ideal solution to many communications problems.

Scientific-Atlanta's ECHELON networks provide the added benefit of the B-MAC secure transmission format. This sophisticated format provides a high level of security while also providing high-quality video, multiple audio channels, high-speed data and teletext. Many businesses, both domestic and international, have already discovered the advantages of private satellite networks, and more and more businesses are sure to follow now that systems are readily available at an economical cost.

THE IMPACT OF SATELLITE TECHNOLOGY ON THE GLOBE AND MAIL, CANADA'S NATIONAL NEWSPAPER

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ABSTRACT

This paper discusses the impact of the Telesat satellite network on The Globe and Mail, Canada's only National Daily Newspaper, against the backdrop of how new technology and major shifts in the world's economy are affecting the world today. The shift in the economies of developed countries from manufacturing-based economies to information economies is reviewed along with the transformation of the world from separate, closed economies into one open, world-scale competitive marketplace. The impact of these trends on Canada and the United States is reviewed along with how The Globe and Mail has responded to the challenges brought on by these changes. The paper concludes with a review of the change process and developing a work culture to deal with change.

I have been asked to speak here today about the impact of satellite technology on The Globe and Mail Canada's national newspaper. For those of you not familiar with The Globe and Mail, I should first provide a brief overview of our newspaper operation.

The Globe and Mail is Canada's only national daily newspaper. Read daily by over 800,000 influential Canadians the paper reaches most of Canada's decision makers in business, industry, and government. A recent survey, for instance, found that over eighty-five percent of the top executives of Canada's largest corporations read The Globe and Mail each day. With the paper's editorial focus on national and international news, and special emphasis on business news, The Globe and Mail is often described as a combination of The New York Times and The Wall Street Journal.

The paper publishes two editions - a Toronto edition averaging seventy-two pages per day distributed in the greater metropolitan area around my home city of Toronto and a National edition averaging forty-eight pages per day distributed throughout the balance of the country. Both editions carry the Report On Business, a separate sixteen-page to thirty-two-page section reflecting the paper's special emphasis on business and finance. Included in the paper every day the Report On Business section is regarded as Canada's national daily business and financial newspaper.

The Globe and Mail also publishes a number of high quality magazines which are distributed, free of charge, as part of the newspaper. These include:

- *Report On Business Magazine*, a monthly business magazine targetted at Canada's business leaders.
- *Destinations Magazine*, a quarterly travel magazine that has become Canada's largest consumer travel magazine.
- Two other magazines carried in our Toronto edition only - *Toronto Magazine*, a monthly urban affairs and lifestyle magazine and *Broadcast Week Magazine*, a weekly program guide for the electronic media.

The Globe and Mail is also well on its way to becoming Canada's largest distributor of electronic data bases. In 1979 we established a separate electronic on-line publishing division and became the first daily newspaper in the world available electronically on the day of publication. Besides offering full-text electronic retrieval of every article appearing in the daily newspaper back to 1978, this division has developed and continues to develop a large number of financial and informational data bases which can be accessed around the world through the telephone networks.

These newspaper products, magazines, and electronic data bases have made The Globe and Mail the primary source of national, international, and business news, and financial and economic information for influential Canadians across the country.

The past ten years have seen significant changes at The Globe and Mail. Like the newspaper industry in general we have experienced a revolution in technology:

- the hot-metal typesetting process has been replaced by photocomposition technology.
- electronic text-editing systems (word processing on a grand scale) have replaced the traditional reporter's typewriter.
- the traditional practice of clipping and filing stories has been replaced by on-line electronic data bases.

- billing, accounting, order-entry, payroll, and circulation systems have all been upgraded to state-of-the-art, on-line interactive systems.

- mailing rooms and loading docks have been mechanized - automating the flow of papers from the pressroom through to the delivery vehicles.

But certainly the most dramatic change at The Globe and Mail, and perhaps the most important innovation in our 142-year history, was the introduction of satellite technology. In 1980, The Globe and Mail became Canada's only space-age newspaper by introducing a National edition printed in plants across Canada from signals bounced off of a satellite hovering over the equator. For over a century The Globe and Mail has dreamt of becoming a truly national newspaper. Away back in 1887 The Globe purchased a train to speed the paper across the province of Ontario. Fifty years later in 1938 The Globe inaugurated an airfreight service to speed delivery across the country. By 1980 the paper had developed a complex distribution network across Canada and around the world. Papers were printed in Toronto and mailed, flown, and trucked to every corner of the globe. Every night papers were trucked to Toronto's International Airport to meet outgoing flights. Papers were flown from Toronto thousands of miles to all parts of Central, Eastern, and Western Canada and abroad. Papers were then shipped by regional airlines, trucks, trains, buses and even boats to smaller centres throughout the country. Needless to say, the distribution chain was complex and unreliable. If our press run was late, we missed the originating flight and all the connecting flights. If Toronto was snow-bound or fog-bound, no flights took off. If it snowed in other centres or they were fogged in we couldn't land. If the plane was overloaded our papers were bumped off the flight. In the Fall of 1980, after one hundred and thirty-six years of circulation development, the national circulation of The Globe and Mail was a mere 12,000 copies per day and accounted for only five percent of our total circulation. The problem was obvious. A daily newspaper needs reliable delivery. Without it, you can't build circulation. And, even if we could build circulation, the delivery costs utilizing airlines would be crippling. And so, in October of 1980 we began a process which would allow us to deliver The Globe and Mail on the day of publication to the doorstep of readers from the Atlantic to the Pacific, across five time zones and over six thousand kilometers.

The introduction of laser scanning, combined with satellite technology allowed us to introduce a National edition of The Globe and Mail and to deliver the product in a timely manner at manageable cost across the country. Today we print the National edition in six locations across the country. Two laser scanners manufactured by the EOCOM Corporation in California are utilized to scan pages of National edition layouts at our Toronto offices - each scanner alternating between loading and unloading while the other is scanning. This data is then transmitted to Telesat's Anik "D-2" satellite which simultaneously relays the signal to each of our remote printing plants. At each plant the signals are received and translated into full-page negatives by two more EOCOM laser scanners acting in tandem - one is loading and unloading while the other is scanning. Because of tight deadlines in the newspaper business and the high costs of transmission the time required to scan and transmit each page is critical. By utilizing two scanners in each location we can process a full broadsheet page in less than sixty seconds. Having two units also provides back-up, a must in our business. Because a daily newspaper is a highly perishable commodity we cannot afford systems downtime. And downtime has certainly not been a problem. In the six years that we have been utilizing the Telesat satellite network we have never missed a printing date. And today, thanks to satellite technology and consistently reliable delivery of our product, circulation of The Globe's National edition is over 135,000 and now accounts for over forty percent of our total circulation. The dream of becoming a truly national newspaper, a dream shared by many previous publishers of The Globe and Mail, has finally been realized.

And the financial pay-off has been enormous. Until recently The Financial Post, a weekly business paper and the only significant competitor and alternative to our National edition and Report On Business section, was the circulation leader outside of our home province of Ontario. As our circulation soared, thanks to satellite technology, Financial Post circulation has declined as readers switch to The Globe and Mail - with its more current news and reliable delivery. The Globe's Report On Business section is rapidly becoming "must" reading in the Canadian business community - and the dominant business advertising medium. Since introducing satellite technology in 1980, circulation has soared - and so has the financial strength of the company. In just six years annual advertising revenue in the Report On Business section has nearly doubled to over $50 million per year.

Clearly, satellite technology has revolutionized our business and is a prime example of how innovative managers, willing to take risks, can substantially strengthen their competitive position in today's marketplace.

And I want to take a few moments now to talk about today's marketplace. Clearly, the world is being transformed from a collection of distinct and closed economies, interacting with one another, into an open world-scale marketplace. This brings with it ferocious competition and intense pressure for cost reductions and increased productivity. At the same time, developed countries are rapidly shifting from manufacturing-based economies to "information economies" resulting in explosive growth in information-related activities. To quote from a recent Science Council of Canada publication entitled "The Uneasy Eighties", "in the transition to an information economy change becomes the new constant. Change itself is the new imperative. The pace of change today is unprecedented, and change itself has become a source of stress that characterizes the uneasy eighties.

J. Robert Oppenheimer, father of the atomic bomb, once remarked: "One thing that is new is the prevalence of newness, the changing scale and scope of change itself, so that the world alters as we walk in it, so that the years of a man's life measure not some small growth or the rearrangement or modification of what he learned in childhood, but a great upheaval."

The prevalence of change and the dominance of the ecomony by information-related activities combine to give the new information technologies the cumulative force of a transformative technology. The nature of their impact on the economy, society, and politics is difficult to predict, but it is safe to say that few areas will be unaffected."

And this brings me to the final point that I want to make. And that relates to the process of change. Change is generally a process of evolution rather than revolution, with most industrial innovations not so much new as they are new adaptations or novel applications of proven technologies. The key words are evolution and innovation. Each and every one of us must foster an environment that encourages change and innovation.

The environment must encourage creativity and innovation - and tolerate risk and the failures that go with it. But that's where evolution comes in - it limits the cost of failure. It keeps the losses within tolerable limits. To pursue undefined markets or opportunities inevitably leads to failure - the risks related to gambling in a business environment are unacceptable.

Change is occurring at an ever-accelerating pace. While it's better to react to change than to ignore it, it's even better to aniticipate change. Rather than being constrained by procedure and tradition, our employees must innovate and initiate change. This means establishing a work culture that is conducive to change. It means pushing the responsibility and authority for innovation to the lowest level possible. It means convincing your people that they work with you - not for you. And it means recognizing that you're only as good as the people around you.

To ensure that all members of the organization are working to a common purpose, senior management must focus on developing strategy and communicating that strategy throughout the organization. As long as each employee understands the corporate objectives, he can be creative and innovative in moving the organization toward those goals. Most of my time for instance is spent communicating - at all levels of the organization. To communicate strategic direction. To exchange ideas so as to help develop strategic direction. To identify problems - and remove roadblocks.

Every organization is unique and must operate accordingly. It is clear, however, that in the 1980's every organization must be innovative and creative to survive - that resilience and resourcefulness are needed to respond successfully to the inevitable shocks and surprises of the future. More and more countries around the globe are now operating at the frontiers of innovation. As a result, each country's growth will depend on entrepreneurial skills and rapid adaptation to keep it at the frontier, rather than catching up to it.

For each of us here today these will be exacting times but they're also exciting times.

Thank you for your attention.

ELECTRONIC INFORMATION DISSEMINATION
OPPORTUNITIES FOR USERS IN THE PUBLIC SECTOR

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Abstract

Continuing pressures on the government sector for more cost effective information services for internal and external users has highlighted opportunities for disseminating information through a range of electronic systems. This paper describes relevant characteristics, opportunities and technologies for Public Sector EID Systems drawing upon recent experiences of the authors and colleagues in the Australian management consulting firm of Coopers & Lybrand WD Scott. A Conceptual Model is presented and application examples discussed together with implementation considerations which appear important for success.

Public Sector Developments and Characteristics

Recent times have seen a number of significant trends developing in Australia and other countries in regard to the way governments view the operations of their various departments, agencies and semi-government authorities. A new emphasis being applied to such bodies, generally in such areas as:

- cost containment or reduction;
- ceilings on staffing levels;
- greater financial and loss acountability;
- greater autonomy, along with self generated funding; as well as
- increasing level of services required.

The application of these trends has coincided with the changed structure of some of the bodies, such as the conversion of the old Post Master General's Department of Australia into the statutory authorities of Telecom Australia and Australia Post in 1975, which today operate as large, essentially autonomous businesses, albeit under some government regulation.

More recent examples of this phenomenon include the recent transformation of the Australian Trade Commission Service under the Department of Trade into an independent commission, using the name AUSTRADE, giving rise to new demands for improved efficiency, effectiveness and revenue flow and the establishment of AUSSAT Pty. Ltd. to provide and operate satellite communications services to the public and private sectors in Australia.

This new performance oriented emphasis, along with a number of other factors related to service provision, indicates that it is appropriate and timely for governments to undertake a new appraisal of the benefits of Electronic Information Dissemination (EID) systems, which embrace telecommunications in general, and Value Added Service (VAS) and Office Information Systems (OIS) which rely on telecommunications, in particular.

The appropriateness of such systems stems from some particular characteristics of the public sector including:

- government offices being distributed over many dispersed locations;
- the limited use being made of new technology by the sector;
- increasing demand from the public for improved information delivery;
- the labour intensive nature of government;
- new emphasis on cost effectiveness; and
- the bureaucratic nature of this sector.

Government business, be it at a Federal, State or Local level is essentially one of information gathering, collation, processing, decision making, and information delivery. It is fundamentally an information intensive enterprise.

Opportunities and Technologies for EID Systems

A number of recent projects undertaken by our firm have confirmed that there is considerable opportunity for government to derive benefit for itself and for the population at large, by embracing Electronic Information Dissemination, whether it is in the form of Value Added Services - such as videotex, electronic messaging or text transfer systems - or Office Information Systems, offering in-house electronic mail, electronic filing and retrieval and electronic publishing facilities.

A number of governments have now recognised that the conflicting constraints of increased levels of service with constant or reduced staffing can only be achieved by going beyond traditional data processing solutions. It is the transport of information and its timely dissemination to those who need it, that is seen as the key to realizing these opportunities.

Naturally, there is no single or best solution to a broad range of information dissemination problems. Some technologies, such as in-house office automation (OA) as available from most computer suppliers, are the clear choice for a government entity that is highly concentrated or localised.

Where communications are to be spread more widely, or the users of the system include the general public, other forms of EID are often more suitable. Such systems should ideally involve:

- inexpensive terminals, preferably of a multipurpose nature;
- inexpensive transmission providing responsive services;
- very easy to use facilities and procedures;
- ready access by the target users.

Videotex clearly falls into this category as it meets the above criteria, provided there are sufficient terminals in locations convenient to the intended users. Electronic messaging systems, such as Telemail and Dialcom type services, tend to be more suitable for the more sophisticated groups of users who need to communicate larger volumes of text information. For an organisation serving many publics, a text transfer system, such as that afforded by teletex, may be more useful than a bulletin board or mailbox based service. A text transfer system such as teletex is something of a cross between telex and a traditional letter, in that it allows the rapid electronic transmission of a document from a sender to a receiver at low cost. A key advantage of teletex when it is implemented nationally is that it is then a standardised means of document transfer. Users of unlike equipment can connect through a suitable interface, thus allowing all such users to exchange documents.

Much of the EID technology that is available today has been available for a considerable time. Videotex, for example, first appeared some 10 years ago in the UK. Likewise teletex and electronic messaging have been available for some 5 years in Europe and USA respectively. However, this is not to say that the technology is static; in fact the opposite is true. While the technology itself is developing, so too is management's skill n applying the technology to meet the demand in a cost effective manner.

A number of new or emerging technologies could have substantial impacts on EID. Some of these include:

- CD-ROM - which is a text and data storage technique based on compact disc technology, allowing the storage and distribution of large volumes of infrequently changing information as an alternative to on-line data base storage access;
- interactive videodisc systems - which merge laser videodisc, computer software and video production technologies; they have found applications in interactive learning and are being investigated for their particular suitability in the next generation of maintenance/repair systems;
- optical memory cards - or laser cards, which use photo-optical recording memories, have a potential application in electronic publishing for the distribution of reference publications, data bases and software;
- ISDN - Integrated Service Digital Network, which will allow high functionality services to be provided to users of private networks, based on all services utilising the same, high performance digital bearer;
- satellite transmission - providing economic communications and broadcast facilities for widely dispersed communities.

Any system planned today must take into account these and other technologies and standards such as:

- other WORM (write once, read multiple) techniques e.g. microforms;
- voice store and forward - "voice mail";
- direct voice to text conversion;
- voice annotation of text;
- local and wide area network services and their relevant standards and protocols;
- document content and document interchange architectures (DCA, DIA) and standards such as X.400 to move documents between different vendors' equipment in a "revisable format";

- facsimile, including direct text and graphics processing interfaces to facsimile.

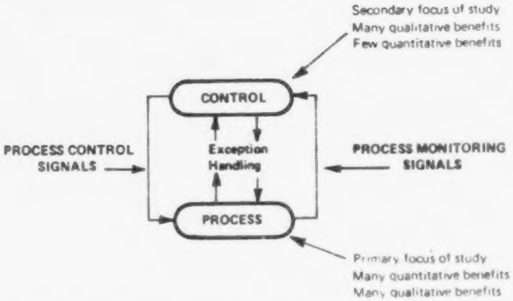
However, despite the promise of each new technological development, we do not believe that an organisation should embrace each and every generation of EID technology as it comes along. Indeed clients are often advised to retain their current systems beyond single steps in EID systems evolution, so that an acceptable level of payback is achieved before more modern technologies are adopted. In general, it is only economic to upgrade an EID system when it lags several generations behind what is currentlfy available. Nevertheless, any such upgrade must look to the future, as stated above, if the investment in that upgrade is to be protected or made "future proof".

Conceptual Model

Our examination of the potential applications of EID technology has been considerably assisted by the development of a conceptual model of a large organisation to which most public sector bodies generally comply. This model was developed by a one of the authors, Chris Ballenden, as part of a major office information systems project for the Australian Taxation Office.

Briefly stated, all organisations consist of a control function and a process function (see diagram 1).

CONCEPTUAL MODEL – DIAGRAM 1.


Secondary focus of study
Many qualitative benefits
Few quantitative benefits
CONTROL
PROCESS CONTROL SIGNALS
Exception Handling
PROCESS MONITORING SIGNALS
PROCESS
Primary focus of study
Many quantitative benefits
Many qualitative benefits

This pattern occurs recursively through the organisation

Usually, the highest level function is provided by head office and the process function is carried out by branch and regional offices. The purpose of the control function is to ensure that the process function always operates within specific guidelines and to implement rapid and effective corrective actions whenever the process function strays outside the established guidelines or parameters. This might occur when, for example, the process function is required to process work in excess of available capacity or which is outside the specifications of the process. The purpose of the control function is to monitor and steer the process function accurately towards the objectives that have been set for it.

The control/process relationship occurs recursively throughout all levels of an organisation. In a branch office, a control function will be found which is responsible for "managing" the section, and a process function which is responsible for actually executing the required operation. For control to be effective, it needs to:

(a) know the current state of the process function; e.g. a work unit is currently running at 70% of its planned available capacity;

(b) be able to forecast quickly and accurately the next state of the process function; e.g. at this rate the unit will not be able to meet its objectives by the end of the year;

(c) rapidly devise and implement corrective action in the process function; e.g. no cases with less than a certain value will be processed by the section this year. The variety of the corrective actions that the control function is capable of generating must equal or exceed the variety of aberrant situations that the process function encounters, otherwise it will lose control of the process function;

(d) monitor the implementation and effect of corrective actions.

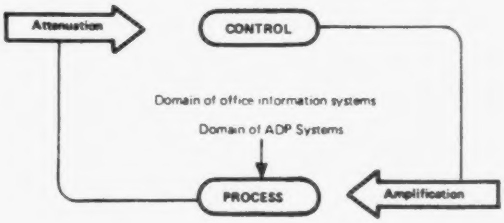
For the process to function effectively, it needs:

(a) the tools and other resources to do the task it was designed to perform within the operational parameters set down by control;

(b) to be able to communicate quickly and effectively with control.

The communication facilities that connect control and process should be capable of two functions: attenuation and amplification (see diagram 2).

CONCEPTUAL MODEL – DIAGRAM 2



Signals from process to control should be attenuated so that control is not swamped with an overload of information. For example, work reports are condensed a number of times before they reach their final destination. Signals from control to process should be amplified so that the variety of corrective actions equals or exceeds the variety of those situations that need to be corrected.

In this model, EID technology generally plays a major role in the control function and a lesser role in process functions. On the other hand conventional data processing and text processing applications play a major role in the process function. This difference in roles is a result of a difference in the thrust and capabilities of the two technologies. In EID technology, the emphasis is on the preparation, communication, storage and access of relatively unstructured text information and on the provision of access paths to other services such as data base systems and subsequently, to the users. In DP technology, the emphasis is on processing data which is input, output, stored and accessed in a highly structured form. EID technology is primarily concerned with reticulating the information or knowledge required for control. The success of any organisation depends to a large extent on how well workers perform their assigned tasks and communicate with each other. Conventional DP functions and EID technology must therefore be highly integrated if the organisation is to obtain the optimum level of benefit from both technologies.

In the model presented above, EID provides a bridge between the control and process functions. In a similar way, EID can provide a bridge between the government entity (in particular, the process functions) and the public, where such a bridge is seen to be necesary and useful. However, the role EID plays in this situation is somewhat different - it is not connecting a process to a higher level of control, but instead extending the reach of the public sector organisation or improving its communications with the public.

Examples of this form of EID are where documents are exchanged by an individual with a government entity - for example, obtaining and compiling a request for services from a utility, obtaining information on government services or paying of utility accounts. Both the public and the public sector entity in these examples can benefit from EID. In the first two instances government would be perceived to be more responsive, as well as involving less effort and time on the part of the user and the provider to deliver the service. In the latter case, an additional benefit to the government enterprise is that the cash flow could be improved. A characteristic of this form of EID which can also benefit the service provider is that it places the burden, and cost, of data entry outside the enterprise, on to the user.

Application Examples

In recent years, our firm has undertaken a number of consulting assignments involving the introduction of EID system in the public sector. These projects have ranged from feasibility studies to detailed development and implementation of EID systems. While they have all been concerned with the efficiency of information processing and transfer, we have seen an increasing emphasis on the effectiveness of the processes and of the information thus disseminated. These assignments have included:

- Telecommunications Authority of Singapore - Teleview Public Access Videotex Project;
- Australian Federal Government - Electronic Publishing and Access to Government Information;
- Australian Customs Service - National Network Planning Study;
- Australian Taxation Office - Office Information Systems;
- Overseas Telecommunications Commission - Office Information Systems;
- Western Australian Government - Government Videotex Information Service;
- Local Authorities Information Services (Victoria) - Local Government and Community Services Public Access System.

All of these projects at the Federal, State and Local Government levels confirmed that the move from traditional to electronic means of disseminating information and providing services to internal and external users can bring significant improvements in:

- cost effectiveness;
- internal efficiency;
- improved service levels to the public; as well as
- job satisfaction for government offices.

We also observed that in many cases, government information has commercial value, which is not always fully appreciated by departmental offices.

Implementation Considerations

Based on our recent experiences, we have identified a number of considerations that need to be taken into account in planning the introduction of EID systems. As evidenced above, such systems can be categorised into the following depending on their orientation:

- internal services, e.g. office information systems:
- external services, e.g. public access videotex systems;
- internal and external services, e.g. electronic publishing and information service.

While the first categories are subsets of the third, and there is an increasing trend toward the third category with integrated services in the public sector, many of the implementation considerations are equally applicable. These include all of the normal considerations for electronic systems but with some additional emphasis on areas such as:

- acceptance of proposed solutions, given differing views within the public sector business units on the problem statement;
- recognition of difficulties in justifying the provision of information based services in terms of quantitative and qualitative benefits;
- acceptance and adoption of technical standards, data and data management protocols, in an interdepartmental environment.

When such systems are extended to the general public, there is a need also to address such issues as:

- standardised, public areas terminals;
- access controls, security and privacy; and, where applicable, "Freedom of Information" legislation;
- system availability and performance.

Unless public access EID systems involve "forced" usage, as with such applications as electronic white pages telephone directory, it is essential for the service provider to ensure that the service will, in fact, be used. In our experience, this can be achieved only where the service provides a level of utility that is not available by other means and fulfils a real and significant personal or business need.

Conclusion

In summary the characteristics of the public sector offer substantial opportunity for the application of EID systems. As outlined in this paper, technologies are currently available to address these opportunities and their application at the Federal, State and Local Government levels. Moreover experience has shown that these approaches effectively implemented, can provide important benefits to both the service providers and users in the public sector.

SESSION 2

Using the Broadcast Medium

Legal Issues Surrounding International Sports Broadcasting

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Abstract

The role of television as an international telecommunications vehicle increases with each passing year. As network and program suppliers extend their product into the seemingly insatiable global market, a myriad of governmental, cultural, legal, economic, and political issues must be addressed. Although the ever increasing number of world wide viewers of television may be diverse, there remains one constant; a love for sports programming. The international distributing of these sporting events offers great economic opportunity, but is shackled to some degree, however, by the transborder restrictions and regulations of the various nations. The focus of this work is to present the possibilities for international television distribution of sports programming and examine the legal and regulatory impediments to the successful distribution of that programming.

I Introduction

Many years from now, when the Chicago Cubs are playing under the lights in Wrigley Field, the sports industry will look back and acknowledge that the advancing technology of television was the engine which drove the industry from a neophyte business to a dominant force in the world economy. Historians will note that it was the integration of the semi-conductor computer chip with the orbital placement of communications satellites which hurled civilization into the 21st century. In the relatively few years since the first sporting event was broadcast in 1939,[1] the television industry has become a dynamic and expanding industry, ever conscious of the growing market for sports programming. Armchair fans, both in the United States and abroad, have demonstrated a seemingly insatiable desire for sports programming, and in its effort to satisfy these wants the television industry has invested millions of dollars into sports programming.[2] Correspondingly, this large influx of capital into the sports industry has given rise to many courtroom battles, with the legal outcome often turning on the intimacies of an inexorably advancing technology which must be governed by an inherently slow-to-change jurisprudential system. During the past 50 years, there has been a rapid rise in the number of sports programs on the air as the networks fight to cover sporting events which run the gambit from baseball to synchronized swimming. New satellite sports networks such as the Entertainment and Sports Programming Network (ESPN) and the Madison Square Garden Network (MSGN), both of which transmit 24 hours a day of sports programs, have flourished along with superstations such as WTBS and WOR[3] which transmit many hours of sports programming each week. As these differing types of technologies have developed, it has been increasingly difficult to legally govern the sports broadcasting industry.[4]

Furthermore, with the penetration of sports programming and the fees paid for the television rights to those events reaching a plateau in the United States,[5] American sports programmers have begun to explore new markets in which to distribute their programs hoping to generate ancillary income. This desire to look for new markets, coupled with the growing viewer demand for American sports programming in other countries,as many Europeans and Asians gain access to new forms of television previously unavailagle to them, paves the way for an explosive global television marketplace. Last year the United States exported over 500 million dollars worth of television programs, of which sports programming was the second largest component, trailing only feature films; and next year and in the years to come we will see this number increase substantially.[6] Currently, the greatest growth component on European television is American football, with NFL games purchased by a consortium of European networks who televise the games weekly in England and in many countries on the continent, including France, the Netherlands, Spain and Italy.[7] This is only the tip of the sports programming iceberg, for without question, there is more sports on world television today than ever before and this trend is on the rise.[8]

However, as American sports programs expand into the international television arena, a plethora of legal issues, both domestically and internationally are triggered,which give rise to numerous and complex questions, each demanding an answer if a world market for television is to thrive. These legal issues, with sociological, political, and economical components, break down into three major problem areas which function to shackle the trans-border flow of television signals: 1) Cultural Protectionism, or governmental actions to impede the importation of programming into their respective countries, usaully in the form of programming content and advertisement restrictions; 2) Technological Regulation, which includes the technical standards, equipment regulation, and government control of the free flow of information; and 3) Financail Regulations, or the issues surrounding taxation, repatriation of currency, foreign investment in televsion entities and suppression of competition through government or quasi-government monopolies.

II) The Global Marketplace

Since the late 1960's, the number of television receivers and the size of the television audience world-wide has grown remarkably; at that time there were approximately 273 million television receivers with an audience of 883,900,000.[9] In the years to follow these figures grew exponentially, where for example, there was a world-wide audience of 600,000,000 for the 1980 Olympic Games in Mexico City, the 1984 summer games in Los Angeles drew well over one billion viewers.[10] Currently there are about 525 million television sets in use throughout the world. Of the total number of sets, the largest single concentration is in Europe with 222 million, followed by North America with 165 million.[11] The third largest market is Asia with 66 million.[12] This 66 million set figure for Asia is misleading, however, because mainland China, potentially the largest television market in the world, though represents to have only 27 million television sets, the estimated viewing audience for those 27 million sets is pegged at 400 million. Coupled with the fact that the Chinese government continues to open up to Western culture in its effort to develop the nation, the television industry can export to grow in a logarithmic fashion.[13]

Beyond the over-the-air television marketplace, aware of the advancing Pay TV technology that segments this market, it is an interesting question to ask, just how powerful a force cable and satellite television will be within the global television industry.[14]

In 1982, roughly 25 million or 32 percent of the then 83 million television households in the U.S. were subscribing to a Pay TV service. By 1990 that figure will grow to almost 60 million Pay TV subscribers or 60 percent of the then projected 100 million television households.[15] Currently in Europe while there are 119 million television homes, only 28 million presently receive television signals over cable systems of one kind or another.[16]

Positioned in much the same manner as the U.S. was several years ago, it is reasonable for Europe to expect growth comparable to that experienced here in the U.S., therefore the demand for more programming almost certainly will increase. Furthermore, the potentially explosive Asian market, with a population of two and one-half billion, has seen the beginnings of Pay TV penetration where in Japan, for instance, 3.3 million or 10 percent of its television homes are wired for CABLE.[17]

Acknowledging the raw power of a global market this size, with the international exchange of television programs growing into adolescence as an industry, two clear trends have surfaced. First there is a one-way flow of programming from the large exporting nations, mainly the United States, to the rest of the world; and second, entertainment material, composed to a large degree of sports programming, dominates this flow.[18] Outside of the United States, imported programming averages approximately one-third or more of total programming aired.[19] Within the large European market several nations are heavy importers of programming; including West Germany where 24 percent of all programming is imported, Finland where it climbs to 37 percent, Ireland at 57 percent and Spain reaching 74 percent, to name a few.[20] Additionally, Asia and the Pacific are large importers of programming, with Hong Kong importing 64 percent, Sinapore 70 percent and Australia 44 percent.[21]

More specifically, as stated, sporting events are perennially a major component of imported programs. In 1983, sports programming comprised 36 percent of all imported television programs into Western Europe, 43 percent of program imports into Eastern Europe, 32 percent of imported programming aired in the U.S.S.R. and 28 percent of the imports to Asia.[22]

III. Government Control of the Marketplace

Historically the over-the-air television which has existed in all nations within Europe and the rest of the world, except the U.S.,[23] has been, for the most part, controlled by state-owned television stations. These state monopolies have traditionally operated off of tax dollars, broadcasting commercial-free programming, not generating any revenue. Specificly, in Europe an annual license fee on television households is levied by these state governments.[24] On the average, a European family pays a 71 dollar per year television license fee.[25] Traditionally, it has been presumed that in return for this fee the household should receive advertisement-free television. Over the years, however, in an effort to underwrite the cost of operating a television network, many state governments have allowed the sale of limited advertising time, under a myriad of restrictions.[26] Estimates indicate that if there were no advertisements allowed then the annual license fee would rise to 105 dollars per year.[27]

Due to its bureaucratic birth state-run television monopolies have never competed in a dynamic marketplace, and as a result, though the programming has been educational and of strong parochial concern, it has often fallen short as an entertainment medium. Coupled with the reality that many nations have a strong desire to strictly control the informational and cultural flow to its citizens, this combination has created a less than vibrant television product.[28] Compounding the bureaucracy, all the state-run over-the-air television networks in Europe formed an association in 1950, the European Broadcasting Union. This association, which helps disseminate programs throughout all of Europe, has also added to the restrictions of the inernational flow of television programs.[29]

Rising out of this restrictive environment, however, private satellite television offers the first non-government owned free market for television programs.[30] Though there are still many restrictions on satellited television, nevertheless, it is the beginning of a dynamic marketplace.

And, as more television program properties are traded throughout the international marketplace, the problem of protecting and properly exploiting these ephemeral property rights in a transnational legal paradigm becomes an enormous task.

IV. Conclusion

The role of television as an international telecommunications vehicle increases with each passing year. As network and program suppliers extend their product into the seemingly insatiable global market, a myriad of governmental, cultural, legal, economic, and political issues must be addressed. Although the ever increasing number of world-wide viewers of television may be diverse, there remains one constant, a love for sports programming. The international distribution of these sporting events offers great economic opportunity, but is shackled to some degree, however, by the transborder restrictions and regualtions of the various nations. It is these impediments which must be over-come, and such in-roads towards a truly international economy shall be lead by the intellectual property of the information age, i.e., television programming. In our new economic order television programming is the first truly global good, in that the technology allows for the penetrations of all geographic regions/ markets instantaneously, and of the barriers of cultural and governmental regulation can be cleared, our planetary society will have taken a major step towards establishing a global free market.

FOOTNOTES

1) On May 17, 1939, two Ivy League baseball teams met to battle for fourth place; Princeton University defeated Columbia Unviersity 2-1 and the sport broadcasging industry was born. *See* Garrett and Hochberg, *Sports Broadcasting and the Law*, 59 Indiana Law Journal 155 (1984). [hereinafter cited as *Sports Broadcasting*.

2) In 1962, the Columbia Broadcasting System (CBS) paid the National Football League (NFL) $4.6 million for the rights to broadcast NFL games that year, and the American Broadcasting System (ABC) paid the American Football League (AFL) $1.9 million; the National Broadcasting System (NBC) did not have a professional football contract in 1962. The NFL's (having merged with the AFL in 1965) current contract period (1982-86) which includes agreements with all three national broadcast networks (ABC,CBS,NBC) is valued at $2.1 billion; which results in *each* NFL club receiving $17 million for the 1986 season from the national TV contract; or a league total of over $400 million for 1986. *See*, Hochberg and Horowitz; *Broadcasting CATV:The Beauty and the Bane of Major College Football*, 38 Law and Contemporary Problems 112 (1975) [hereinafter cited as, *Broadcasting and CATV*]; and *CABLESPORTS*, Vol.3, Issue 36, Nov. 4, 1985.

It is estimated that the NFL will have total revenues of over $700 million for 1986 and with $400 million or almost 60 percent coming from television, the league's dependence on the sports broadcasting industry becomes apparent. *See Television Sports Rights,* QV Publishing, Inc. 36 (1986). [hereinafter cited as *Television Sports Rights*].

3. "Superstation" is a term of art which refers to an independent over-the-air station which has its signal picked-up off the air, without its permission, and then transmitted to a satellite which in turn re-transmits it bakc to earth.

4. Sports Broadcasting is governed by several statutes including the Communication Act of 1934, 47 U.S.C. Sec. 1 et.seq., The Sports Broadcasting Act of 1961, 15 U.S.C. Sec. 1291-95 (1982). The Copyright Act of 1976, 17 U.S.C. Sec. 1 et seq.and the Cable Communications Act of 1985; Beyond these statutes, it is important to realize that sports broadcasting is governed by a complex mixture of governmental agencies including the Federal Communications Commission (FCC), the Register of Copyrights, the Copyright Royalty Tribunal (CRT), the Federal Trade Commission (FTC), and the Department of Justice.

5. *See generally, Why TV Sports are in Big Trouble,* Sports Illustrated. January 25, 1986.

6. *Variety,*2/5/86. Television programming, with sports as one of its major components, makes up a substantial part of the growing U.S. service export industry, a vital part of the U.S. quest for a balance of trade. As our world's evolving information-based economy develops, there will be a shift from manufacturing domination to an economic paradigm in which the U.S. service industries will account for two-thirds of the gross national product and about 70 percent of employment. *See*, *U.S. Completes Its Study of Services Trade, Hoping for Another GATT Round*, 20 U.S. Export Weekly (BNA) 493 (Jan.3, 1984); *BLS*, *Commerce Likely to Receive Funds to Update Service Sector Data Services,* 20 U.S. Export Weekly (BNA) 309 (Nov. 22, 1983); *See also*, Porat, *Communications Policy in an Information Society,* in Communication for Tommorrow. Policy Perspective for the 1980's 3 (G. Robinson ed.1978); *and* J. Pelton, Global Talk 165-79 (1981).

7. *See, Sporting Salesman's Goal,* TV World 28 Dec./Jan. 1985/86. Beyond the traditional television sports of football, baseball, golf, basketball, tennis, etc., there has been a growing world-wide phenomenon in the sports broadcasting industry euphemistically referred to as "professional wrestling". Though many sports

authorities do not consider this a sport, preferring instead to refer to it as entertainment, professional wrestling, highlighted by the likes of Hulk Hogan, Rowdy Roddy Piper, The Iron Shiek, Giant Haystacks, and GLOW "Gorgeous Ladies of Wrestling", nevertheless, enjoys one of the highest ratings in the television industry. This is true not only in the U.S., but also in Europe where a weekly two hour show on a European satellite network is that channels highest rated program. See, Muscling in on the Make-Believe, TV World 30 Dec/,Jan. 1985/86.

8. The best example of the power of television to crack the world marketplace was the 1984 Los Angeles Summer Olympic Games which were seen by over one billion people in over 50 countries around the world. See, C. Firestone, International Satellite and Cable Television, The Fourth Biennial Communication Law Symposium, Resource Manual; UCLA Communications Law Program 164, 1985. [hereinafter cited as International Television].

Additionally, many nations around the world are seeing large increases in the amount of sports aired on television each year. The best example of this can be found is in Italy where sports time on Italian television continues to rise by ten percent each year. See, Sport: Italy, TV World 27 Dec./Jan. 1985/86.

9. See, T. Varis, The International Flo of Television Programs, 34 Journal of Comm. (1984).

10. Id.

11. See, International Television, at 242. As part of the North American figure, the United States represents the lions share, with almost 85 million television homes, many of which have two or more sets. See, Nielsen Report on Television, 1985, at 3.

12. See, International Television, at 242.

13. See, B. Redmont, Inside Chinese Television: A New "Great leap Forward", Television Quarterly winter 1985, at 8. This market represents a potential gold mine for television programers, and some U.S. networks have already begun to export programs to China. See, infra, note ___ and accompaning text.

14. See, Frost and Sullivan, Inc., The European Cable TV Market 196 (1983)]hereinafter cited as European Cable]. It is interesting to note that as explained, supra, note ____, ppv will be the next force in television marketing, today in the U.S. and tomorrow in Europe and the rest of the world; and acknowledging that this type of service, will have a growth of almost 44 million in the U.S. by the end of the decade, it is reasonable to expect that the need for special event programming, which sports contests often provide, will be experiencing an increasing demand.

15. See, Curopean Cable, at 196.

16. Id.

17. Id., and see also, Japan: Cable Gets Moving, TV World, Feb. 1986, at 16.

18. See, T. Varmis, The International Flow of Television Programs, 34 Journal of Comm. (1984).

19. Id.

20. Id.

21. Id., It is interesting to note that the U.S. imports only 2 percent of its television programming.

22. Id.

23. Since its inception, the U.S. television industry has always been privately owned, operating in an advertisement/subscriber supported free market, regulated to some degree by the FCC, but never has the gobernment had any ownership interest in a television network; historically, the U.S. has been steeped in a long tradition of a right of free access by all to over-the-air television signals intended for the general public. It is interesting to note though, that due to United Nations Agreement the U.S. had to sanction a private

monoply in the international satellite transmission industry which has raised many legal issues concerning the free flow of international television programs.

24. See, B. Maddox, The Theology of Satellite Television, Television Quarterly, winter 1986, at 44.

25. See, J. Taks, Stop Your Meddling, TV World Dec./Jan 1985/86 at 21.

26. These restrictions on advertisment are a major impediment to the flow of international television programs.

27. See,J. Taks, Stop Your Meddling, TV Wrold Dec./Jan. 1985/86 at 21.

28. The lack of first amendment type rights and strong cultural protectionism also operates as a block to the flow of international programming.

29. The formation of this association, and its restrictive effect on the flow of television programs raises several anti-trust questions.

30. In addition to the rise of private satellite television, some nations in Europe and the rest of the world, have begun for the first time to allow private advertisement supported over-the-air broadcast stations to be licensed. Specifically, Denmark has allowed private stations to broadcast, and though advertisement is restricted in Denmark, the private channel survives as a Pay TV service, generating revenues from subscribers; see, Denmark: Countdown to Commerical TV, TV World, Feb. 1986. And Ferance, has also opened its doors to private television, wherein the socialist government has granted several licenses for the operation of private broadcast stations. See, Le Developpement des Televisions, Lettre de Matignon, Aout 5, 1985, at 2 and see also, Une Televisoni de la Creation vivante et du patrimoine, Le Monde, Feb. 15, 1986.

TELEVISION IN INDONESIA
TOWARDS A REVOLUTIONARY INFORMATION ERA

Ishadi Sk
Television of the Republic of Indonesia
INDONESIA (TVRI)

The Palapa Domestic Satellite, launched 10 years ago by Indonesia, has succeeded in joining the 200 ethnic groups of the country, which colonialism had tried to keep apart for 350 years.

In 1985, the Palapa B1 steered off course from its orbit causing two thirds of Indonesia's communication system to black out for 3 days. Communication links as well as television contact were impossible to achieve, yet there was no intention of turning from this sophisticated hardware and resorting to other alternatives. The satellite system undoubtedly has great advantages, yet it also entails great risks and causes dependency. Nevertheless, due to the fact that this system is ideal for the geographical conditions of Indonesia, the system will remain.

In February 1984, Challenger was unsuccessful in orbiting the Palapa B2. The satellite strayed from its course after separating from the craft at a height of only 200 km above ground. This incident meant that Indonesia, which had initiated using domestic satellites since 1976, was fully dependent upon Palapa B1. The older A2's power, after seven years of operation, was beginning to weaken.

Eighteen months later, on August 30, what was always feared, happened. Palapa B1 encountered problems, causing it to stray from its eastern longitudinal position of 108.0° to 106.2°. Alarms started to blare at 4:20 am, the Cibinong Palapa Satellite Control Center reported the fatal change, which resulted in a total communication system blackout for hours. Television was the most affected; broadcasts from Jakarta were cut off for three days in 12 provinces in East Indonesia. (1)

This incident did not discourage Indonesia or discredit the Palapa satellite system. This system was the only alternative applicable, and for the past eight years, it had proven itself to be a vital factor in uniting all areas within the country, stretching over three million square miles.

One third of Indonesia which was cut off from its terrestrial microwave reserve channels was able to be reconnected after around three hours. The remaining two thirds of the country had to wait three days for the Cibinong control center and Norad (North American Radar) to return the satellite to its proper position.

During this three day blackout, emergency measures had to be taken, including recording and sending all programs from the central TVRI station in Jakarta to regional stations. Areas which did not possess their own local station simply had to go without television for that period of time. Other bodies and activities which relied on the Palapa for various communication purposes were also greatly affected, for instance, ships at sea, air traffic control, banking and logistic depots. Malaysia's and Thailand's television activities were also disrupted until they transfered their transmissions to Intelsat or Palapa A2 (reserve).

This incident came as a disturbing surprise; previously no such problems had ever occurred and the whole system had operated smoothly.

Why did Indonesia choose such a complex, high-risk system, whereas the country itself was technically incapable of handling the sophistication of such extravagant space technology?

1. INDONESIA'S GEOGRAPHICAL SITUATION

To comprehend why Indonesia decided to purchase the satellite in 1976, one must first understand the complex geographical conditions of the country. It comprises 13,600 islands with only one-fourth populated. The nation's 175 million people are spread out on the five main islands with two thirds inhabiting Java.

The islands stretch as far as 3,200 miles, the same distance as San Francisco to New York or London to Istanbul. The whole of Indonesia, land and sea area, measures three million square miles.

The region is divided into 27 provinces which initially developed from the larger individual ethnic groups. Over 500 dialects are spoken throughout the regions. The various cultures and languages were finally united when Indonesian was formally accepted as the national language some 60 years ago. This national language then became the common factor which the people of Indonesia used to unite in their struggle for independence from 350 years of colonialism.

In the 1970's, Indonesia, in its efforts to support its economic development, was searching for a communication system which could integrate the whole country. At the same time, the government had just completed the construction of a ground microwave terrestrial network connecting Jakarta-Bali and Jakarta-Medan-North Sumatra (the Trans Java and Trans Sumatra Microwave Network). The project, which took close to 9 years to build, was only able to cover a range of one tenth of Indonesia as a whole. Follow-up discussions revealed that it would take another 15-20 years before all of Indonesia could be covered.

It was finally decided that Indonesia would have to resort to communication satellite services. Indonesia purchased its own domestic satellite, making it the first for the developing countries and in third position after the United States and Canada. Domestic Satellite Hs 333, possessing 12 transponders each with a capacity of 400 telephone lines, was launched on July 11, 1976 at an eastern longitudinal position of 83°. A reserve satellite (Palapa A2) was launched 10 months later, positioned at 77°.

Several considerations were taken when trying to decide whether to purchase a satellite or rent transponders from Intelsat. The include :

1. Intelsat's High Power Beam (E.I.R.P.) 23dBW is weaker compared to Palapa's E.I.R.P. of 32dBW. This means that Intelsat would need a larger Earth Station antenna (10 m.) compared to the one needed for the Palapa satellite (5 m.). Thus Palapa earth stations would only cost half the price to build. (2)

2. Palapa's capacity of 24 transponders (A1 and A2) would make it possible to add channels, whereas this would be limited if Indonesia rented Intelsat transponders.

3. Indonesia, which is located within the Geo Stationary Orbit (GSO) region could easily control and monitor its own satellite.

4. In the long run, ownership of a communication satellite would bring about other financial and technological advantages.

Within only 18 months after the satellite was launched, Indonesia completed the building of 40 satellite ground stations throughout the provinces. Telephone, telex, telegram and television connections were simultaneously installed throughout the country.

With this satellite, Indonesia took a giant step in the field of communication technology, bringing the nation into what Alvin Toffler called the "information revolution" or the "third wave". (3) This revolution at first only swept the more developed nations, but the Palapa opened doors for Indonesia which made it possible for the country to go ahead of other Third World nations. Proof of this tendency is becoming more evident today.

2. COMMUNICATION TECHNOLOGICAL BREAKTHROUGHS

Two years after the Palapa was launched, Indonesia began developing its own earth station industry. When the Philippines, Malaysia and Thailand decided to rent Palapa services, they also decided to use earth station components made in Indonesia.

Other benefits included the increase of demand for telephone connections by 80% annually. Telex and telegram networks were further developed for sea, air and oil mining communication purposes, as well as trade and banking. Main frame computer network systems are now being used for campaign monitoring, the recording of Family Planning logistics in the country and nationwide university entrance exams.

The print media are also enjoying advantages of the satellite. Telephoto, teleprinter and facsimile are now widely used between magazines and newspapers located in different provinces. The fever of communication technology has even affected the rural areas. As an example, a local newspaper in Yogyakarta reported that villagers are diligently setting up self-made intercom systems. They designed simple intercoms by combining components such as mini loudspeakers of 0.3 watts/ 8 ohms, microphone condensors and an IC L.A. 4100 or 4102. One battery-operated intercom is priced at not more than $3 and is connected by wire or remnants of an old transformator. The system can connect a large number of houses within a village or located in different villages. Crude bamboo poles are used to support wires stretching for as far as 10 km. This sytem has proven to be very effective for announcements, to call villagers together as well as a means of two-way communication. (4)

The Palapa has also brought changes to urban telephone systems. The sudden increase in demand for touch-tone telephones is difficult to meet, though channels between Palapa and its earth stations are ready to accomodate such demands anywhere in the country. In Jakarta, Surabaya, Bandung and surrounding areas, cellular telephone connections have been built since 1980. (5)

Meanwhile, preparations for the Integrated Services Digital Network (ISDN) in Jakarta and other big cities are underway. The ISDN is then to be followed by the opening of a digital telephone company in Bandung, to be completed by 1990. (6) As the system still seems insufficient, Jakarta is also preparing additional telephone lines using optical fibre. (7) Only with this new system will demands for telephone lines be completely fulfilled.

3. INDONESIA'S TELEVISION NETWORK

Indonesia set up its national television network, TVRI, on August 23, 1962, to host the Fourth Asian Games. A studio with the capacity of 5 kilowatts was built near the sports complex, at the same time the new stadium was being constructed.

For the first time in Indonesia's history, some 10,000 black and white television sets were sold to the public of Jakarta two months prior to broadcasting.

TVRI's logo first made its appearance on television screens throughout the capital city on August 17, 1962, with live broadcasts of Indonesia's Independence Day commemorations at Jakarta's palace grounds. Following the completion of the Asian Games coverage, TVRI took further steps to develop, yet things did not run as smoothly as expected. In 1965, a regional station was built in Yogyakarta to promote local cultural arts. TVRI's activities began to pick up in the 1970's.

The oil boom brought in profits for the nation, making it possible to build seven more regional stations within only five years. These stations are located in Medan (North Sumatra), Palembang (South Sumatra), Surabaya (East Java), Denpasar (Bali), Balikpapan (East Kalimantan), Ujung Pandang (South Sulawesi) and Manado (North Sulawesi). Their main functions are to :

1. relay programs from Jakarta's TVRI station;

2. produce and broadcast local programs (2 to 3 hours daily);

3. produce packaged programs to be broadcasted nationally from Jakarta.

Several years following the development of the regional stations, some fundamental weaknesses were noticed : (8)

1. Hardware was relatively easy to obtain. Studio equipment, cameras and other supporting devices were easily acquired as the funds allowed. However, operators, cameramen and professional crewmen were hard to find. The seven new studios required some 1,500 skilled workers who were rarely available due to lack of education and training of television broadcasting in Indonesia.

2. The high cost of television studio operation. Funds provided for the building of a new television studio did not include yearly allowances for operational costs which were found to be substantial.

3. Several regional stations were faced with difficulties in obtaining broadcasting materials. Sources for local programs (including music, traditional dances and drama) were limited, resulting in inaccurate time scheduling.

These reasonings have shifted the direction of TVRI's development. The government, with full authority over the development of the regional television stations, decided to discontinue the program and provide the other eighteen provinces with mobile television broadcasting units instead. These TVRI regional OB-van units are to produce and send programs to Jakarta to be broadcasted nationally. The concept was supported by the discovery of Electronic Field Camera (EFP). In 1979, the government purchased ten "Bosch Fernsehen"EFP OB-Van units from West Germany. Each unit consisted of three EFP cameras, sub-control, one-inch VTRs, an editing machine, one electric generator unit and a crew vehicle. Its mobility makes the operating of the unit in remote locations highly effective. These units were distributed to ten provinces throughout the country to produce television programs to be aired nationally via the Jakarta central station.

With the launching of the Palapa satellite in 1976, TVRI's programs have gone through great changes. The vast islands of Indonesia were united by the television network which was designed to equally portray the faces of each region. The concept has been known as the Archipelago Approach.

4. THE ARCHIPELAGO APPROACH

The Archipelago Approach was first proposed in the field in 1981 by Drs. Subrata, the Director of TVRI at the time. (9) The concept is reflected through TVRI's programs to serve the needs of every region. The approach basically centers on the efforts to obtain live coverage by maximizing the use of the OB-Van, EFP and ENG (Electronic News Gathering) units in villages and remote areas. Local traditional arts, culture and drama were to be covered on the spot. Some of the advantages of this method are as follows :

1. There is no need for TVRI to build television studios in all of the 27 provinces or in other cultural centers.

2. Panoramic scenery (i.e. mountains, rivers, paddy fields and village houses) in the background gives the actual view of life in the village concerned, therefore additional background decorations are unnecessary.

3. Artists and dancers can perform anywhere without having to be present at the studio.

4. The local people may act as live audience as well as participate in the program itself.

5. Production costs are relatively low due to the mobile crew unit provided.

6. Coverage of the daily life of the local people brings forward a more natural view of the actual scene. (10)

This includes the use of the ENG units to cover several rural programs such as "Our Village", "From One Village to Another" and "Rural Development" where they focus on providing information about cultivation, plant diseases, water purification, fish breeding and family planning program.

Supporting facilities for TVRI productions include :

1. ten mobile television station units which are continuously working in the ten provinces;
2. 14-hectares of land as a village-setting outdoor studio, built to provide the perfect scenery for several TVRI drama serials;
3. twelve OB-Van units at the Jakarta central station and those at the eight regional stations;
4. ENG units in Jakarta, mobile units and 30 regional stations;
5. supporting factors from other institutions outside of TVRI (including their own ENG units).

With this, almost all of TVRI's programs are self-produced. (11) Programs produced by the regional stations, the mobile and the ENG units are scheduled for broadcasting in a certain pattern referred to as the Integrated Broadcasting Pattern.

5. THE INTEGRATED BROADCASTING PATTERN

The main difficulty in carrying out this approach lies in coordinating various factors. The present TVRI Director (1986), Alex Leo, introduced the concept of the Integrated Broadcasting Pattern. In this concept, a broadcasting schedule is formulated on a 12-month basis. This includes time scheduling for programs contributed by each regional station, overall duration, types of program, format and the script outline. The regional stations should follow instructions found in the basic guideline book which regulates production sites, scheduling and when the package should be sent to Jakarta and broadcasted.

Materials received in Jakarta will be edited, then reproduced at the post-production unit for an overall polish. Unacceptable material will be returned for correction. This whole concept requires tight discipline and control from the central TVRI station. Crewmen, producers and additional facilities may be sent for from Jakarta if necessary.

The advantages of the Integrated Program Pattern include :

1. the avilability of an adequate supply of material ready for broadcast from regular contributions by all stations;
2. easier content analysis of production;
3. the assurance of equal broadcasting opportunities for every region.

Evaluation of programs is conducted twice a year by all regional station managers. A yearly festival is held to select the best programs produced by stations throughout Indonesia, which will be aired in a special program entitled "TVRI Awards".

The following is an example of an Integrated Program Pattern :

Sunday, January 12, 1986

17:00	Regional News, contributed by all regional stations
17:30	"Indonesian Children", contributed by six regional stations
18:00	Imported film series
19:00	Regional News, contributed by all regional stations
19:30	Religious Programs
20:00	Drama, contributed by a regional station
21:00	World News
21:30	Music, contributed by a regional station
22:30	Imported film series
24:00	Closing

6. RURAL BROADCAST

Keeping in mind that 65% of Indonesia's total population is concentrated in the rural area, rural broadcasts were considerably increased in 1981, reaching 20% - 25% of the whole television program. These programs focus on village aspects with discussions concerning problems found in villages. Rural programs, particularly aired by regional stations, are supported by viewer groups. The groups follow the rural broadcasts, evaluating each program and, acting as opinion leaders, spread their knowledge to the community. Group members are also included in meetings with TV producers and often provide information on matters pertinent to the program, thus giving feedback to TVRI. In rural areas, programs work in cooperation with rural newspapers (which receive subsidy from the government). The newspapers publish reviews on programs to be broadcasted. This adaption of Lerner's Theory of Innovation is probably the most accurate. (12) A research conducted by Astari proves that TVRI's rural programs further supports Lerner's theory. (13)

7. THE USAGE OF PALAPA

Current Director of Television, Alex Leo, plans to put into use Palapa B2's transponders after its launching in 1987. The satellite will provide 24 additional transponders to the amount already owned by Palapa B1. According to plans, up-link stations will be built in several areas, so as to enable direct broadcasting from the chosen area using the satellite (similar to Mexico's TV program currently showing, "Simple Domingo").

The Archipelago Approach will be realized when this is put into operation.

8. SIDE EFFECTS OF SATELLITE

The immediate effect in using the satellite technology for TVRI is spill-overs. This has happened as three of Indonesia's neighboring countries also use the Palapa satellite for their own domestic television broadcasts. Since 1969, Malaysia, Thailand and the Philippines each rent one transponder. Thus, using a simple parabolic antenna with a diameter of 3-5 meters, Indonesian TV viewers can easily receive broadcasts from the three countries mentioned.

Despite government regulations in August 1986, parabolic antenna usage and prevention of spill-over is difficult to carry out. Spill-overs to and from neighboring countries can also happen without the use of a satellite. It is reported that TV viewers in North and East Sumatra have access to broadcasts from Malaysia, Thailand and Singapore (14), while viewers in East Nusa Tenggara can tune in to Australian programs just by connecting a self-made "booster" to their RV antenas. Spill-overs can also happen through video cassettes. There is no concrete figure on video circulation, but with the growing number of video rental shops throughout the country, it can be assumed that videos are no longer considered a luxury. The relatively inexpensive video rental cost of Rp. 1,000 per day (around $.50 cents) make video programs popular entertainment; shown in restaurants, train stations and inter-city buses. The circulation of video cassettes is hard to control, making it possible for cassette piracy and the circulation of x-rated films.

9. THE THIRD WAVE IN INDONESIA

The Palapa satellite not only unites Indonesia into one communication and information channel, but also brings Indonesia a step closer to the information revolution or the Third Wave. This "wave" in the community is marked by the mass usage of photocopying machines, calculators, fast photo reproductions (ready in 30 minutes), computers, citizen bands and facsimiles. The communication system has progressed significantly and is being used in effective ways by the public.

The Packet Switched Public Data Network, established in 1984, in Jakarta, Surabaya, Bandung, Medan and other big cities is connected to international data centers in Europe, Japan and the United States. This system uses Palapa satellite services (the first time in the world for a domestic satellite to be used for the Data Network).

Information on market conditions and prices of basic needs such as vegetables and other commodities are broadcasted through community radio programs. Radio stations, managed by the private sector and community groups total seven hundred throughout Indonesia.

Electronic equipment repair services have multiplied rapidly. Many shops selling components and all types of ICs can be found among shops offering other goods.

The Third Wave has penetrated the Indonesian community, in villages as well as big cities without causing significant disturbances. Servant Schraiber and Everett M. Rogers'(15) estimation that the Information Revolution would be beneficial to an industrial as well as a developing country has been proven accurate in Indonesia.

This began with the usage of the Palapa satellite in 1976, establishing an information distribution system which can cover the entire nation.

The Palapa satellite has made it possible to improve television broadcasts and establish a communication system, a long distance education program through television; develop an inter-regional information channel, and most importantly, unite the various ethnic groups found in the country to aim towards a common perception and goal.

Palapa has made it possible for Indonesia to greatly advance in the storing, processing, reproducing and transmitting of information.

H.E. Hudson classified development in these fields as follows : (16)

Storage	Processing	Reproduction	Transmission
Clay	Abacus	Copying (Scribe)	Transporation smoke
Bamboo	Calculator	Printing press	Carrier pigeon
Paper	Computer	Photography	Wire,cable, wireless
Magnetic tape		Xeroxgraphy	Broadcast, optic fibre
Optical disc		Offset	
		Electronic	

A communication system using a domestic satellite has made it possible for Indonesia to advance in the points shown in the Hudson matrix, more rapidly than other developing countries.

10. CONCLUSION

The Palapa satellite has made it possible for Indonesia to make breakthroughs in its development; the initial breakthrough being the setting up of an integrated communication network. Later, advances were achieved in the field of television broadcasting. A six-year study conducted jointly by the East West Center and the Indonesian Scientific Institute (LIPI) showed that television broadcasts using the Palapa has increased the public's national awareness considerably; increased the rural community's ability to speak the national language, and has proved to be an effective agent of innovation in the sectors of agriculture, education, family planning and public health. The television satellite has also succeeded in narrowing the information gap between urban and rural areas. (17)

The incident of Palapa B1 steering off course in August 1985 has brought about great material loss. But in spite of this, Indonesia will still rely on satellite as its main communication system (Indonesia plans to launch a larger satellite in 1992). This incident is a risk that must be taken if breakthroughs are to be achieved.

Several ways of optimizing the use of the Palapa satellite are as follows :

1. usage of Palapa for educational programs, putting into operation transponders not being used during the day;
2. usage of Palapa B2's additional transponders for broadcasts in the ASEAN region;
3. usage of used transponders for improving community communication systems in rural areas with the aid of small parabolic antennas. This is seen as an effort to overcome the low telephone density in Indonesia (in 1985, only 750,000 telephone lines for every one hundred citizen); (18)
4. usage of transponders for expanding national television channels in order to increase information channels;
5. to develop the information technology.

These are several ways to optimize the use of the satellite, which for ten years has enabled Indonesia to make major breakthroughs in development. The next decade promises further advantageous steps.

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REMOTE COMMERCIAL TELEVISION & TELECOMMUNICATIONS IN AUSTRALIA

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The Golden West Network has mounted Australia's first Direct Broadcast Satellite system to bring radio, TV and data services to small communities and isolated ranches in the continent's vast 'outback'. It's a risky venture, trying to cover an area 1/3 the size of the United States but with only 350,000 people. This paper describes the technical system, the financial requirements, the potential with the philosophy that led Golden West to take on the task.

Last year The Golden West Network in Western Australia became the first commercial station to undertake a Remote Commercial Television Service (RCTS). It is a pretty risky venture, considering the state's vast size (one-third of the United States) and the very low density of population, especially since it has required a capital investment of over $7 million and has a recurrent cost of over $3 million per year.

To survive, the RCTS licencees need to find revenue over and above the traditional income from the sale of advertising time. Fortunately Scientific Atlanta's B/MAC system that was chosen for Australian satellite broadcasting, has considerable excess capacity that can be used to generate that additional revenue.

There are several regulatory issues that stand in our way, mostly due to the quasi-government telecommunications monopoly (Telecom Australia) having a stranglehold on the industry. However, before examining the regulatory environment, it might help to have an overview of the system.

AUSSAT, as our Australian domestic satellite network is called, consists of three KU-band satellites, each with four 30-watt and eleven 12-watt transponders, divided into switchable national and regional spot beams. The 30-watt transponders are dedicated to remote television, one for the Australian Broadcasting Corporation and one for commercial TV in each region. The remaining high-power transponders have gone to New Zealand and two pay-TV operators.

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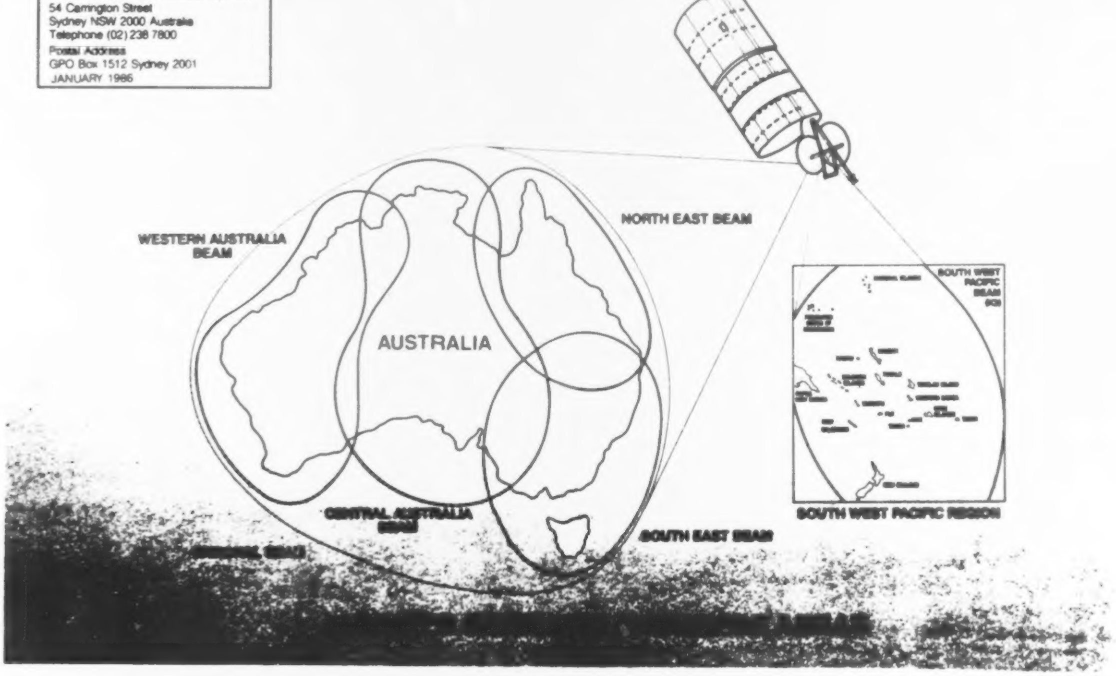
JANUARY 1986



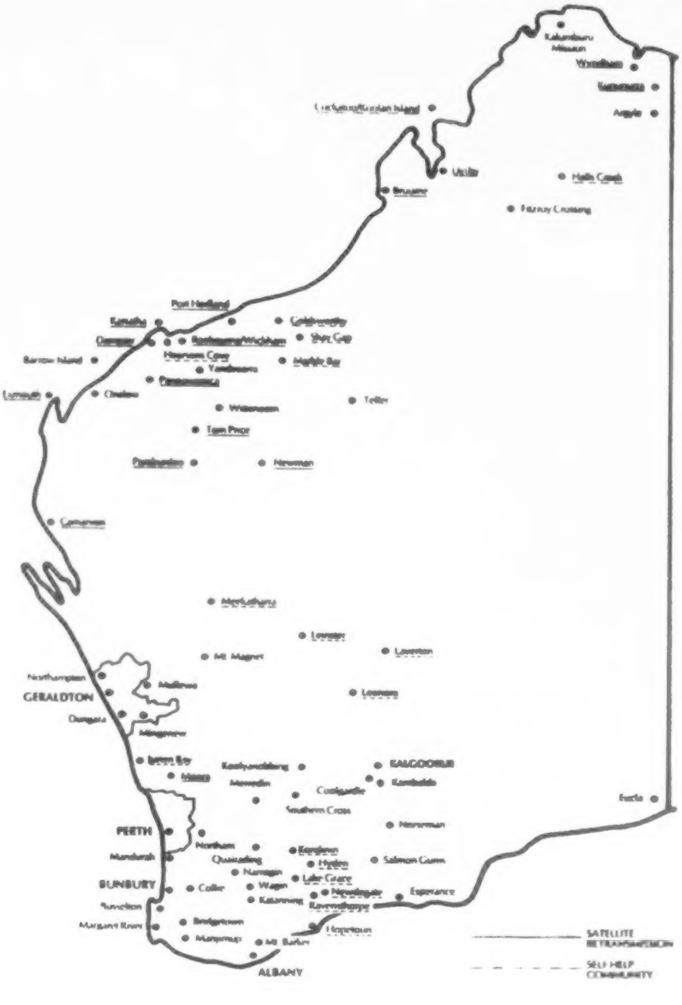
THE SIZE OF THE PROBLEM

Australia has about 16 million people, so dividing it into four satellite beams sounds as if there might be a fairly lucrative television market. However, forty-three per cent of the people live in Sydney and Melbourne, half of the rest live in Brisbane, Canberra, Adelaide and Perth. The licences for Remote Commercial Television Services (RCTS) expressly exclude these capital cities, as well as all towns already covered by regional television operators. This leaves a very slim market indeed for the would-be RCTS operator, and there is already some doubt as to whether other licencees will proceed.

For example, Western Australia has a land area of 2.5 million square kilometres, or about one-third the size of the United States or roughly 90% of Western Europe. The state's population is 1.44 million, but 998,000 of them live in Perth, and another 35,000 live in the Geraldton region. Both of these areas are already served by existing licencees, who are legally protected by any competition our service might offer. On top of this limitation, we are required to construct re-broadcasting transmitters in all communities over 1000 people, in our case 14.

GWN

THE GOLDEN WEST NETWORK COVERAGE AREA


Kalumburu Mission
Wyndham
Kununurra
Argyle
Cockatoo/Koolan Island
Derby
Halls Creek
Broome
Fitzroy Crossing
Port Hedland
Karratha
Goldsworthy
Dampier
Roebourne/Wickham
Shay Gap
Barrow Island
Hearson Cove
Marble Bar
Yandeyarra
Pannawonica
Exmouth
Onslow
Telfer
Wittenoom
Tom Price
Paraburdoo
Newman
Carnarvon
Meekatharra
Leinster
Laverton
Mt. Magnet
Northampton
Mullewa
GERALDTON
Leonora
Dongara
Mingenew
Jurien Bay
Koolyanobbing
KALGOORLIE
Moora
Merredin
Coolgardie
Kambalda
Eucla
Southern Cross
Norseman
PERTH
Northam
Kondinin
Mandurah
Quairading
Hyden
Salmon Gums
Narrogin
Lake Grace
BUNBURY
Collie
Wagin
Newdegate
Esperance
Busselton
Katanning
Ravensthorpe
Margaret River
Bridgetown
Manjimup
Mt Barker
Hopetoun
ALBANY
SATELLITE RETRANSMISSION
SELF HELP COMMUNITY

THE COST OF RCTS

Given the geographic, demographic and political constraints, the costs for regional operators mount much more quickly than the revenue: an 11-metre uplink @ $1.5 million, 14 retransmission sites @ $125.00 each, more than $1 million in studio equipment, and -- by government demand, a B/MAC encoding system at $1 million. In all, the capital investment for our Western Australian RCTS is about $6.7 million. The eastern states licencees have it a little easier, in that they can do their uplinking through AUSSAT's major city earth stations for a relatively low annual fee.

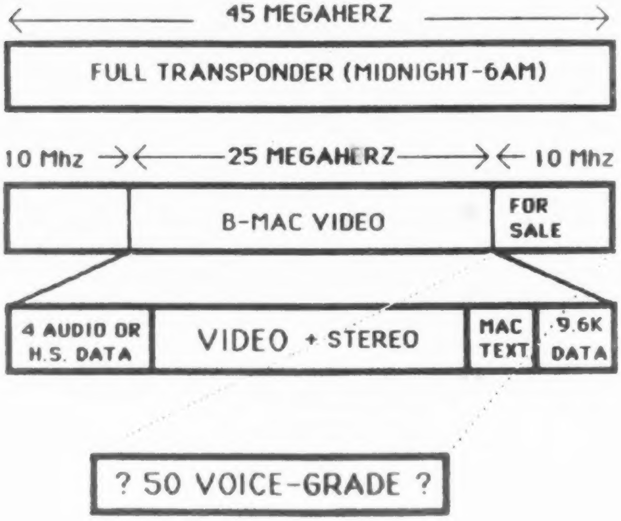
That's just the capital costs. Recurrent costs are $3.2 million per transponder and, at a time when telecommunication prices around the world, are falling AUSSAT raised its tariffs by 11% last year -- and will try to do it again.

It is quickly apparent that RCTS licencees cannot survive these costs if they depend on advertising revenue alone. In the eastern states, regional stations can offset the AUSSAT costs by eliminating the massive bills from Telecom for program distribution bearers.

In our case, the State Government had to put up a $2 million subsidy to AUSSAT to bring costs down to the point where we (and our competition) were willing to apply for the licence.

However, as any private company, we don't like the sound of the word 'subsidy' being connected with us in any way, even though we don't see a cent of the money. For this reason, we have embarked on a campaign to sell off the portions of the transponder that we don't need (we're required to lease an entire transponder, whether we use it or not) and to market value-added services that will allow us to carry all of the costs, independent of government.

To understand how that's done, requires an idea of what we have to sell, which means an understanding of Scientific Atalanta's 'B/MAC' television transmission system. B/MAC needs just 24MHz of the 45MHz capacity available on AUSSAT transponders. Unfortunately, it demands just over 90% of AUSSAT's transponder power, which means that outside capacity is limited to about 50 SCPC channels or three 2-megabit streams.



RCTS

TRANSPONDER CAPACITY

BUSINESS OPPORTUNITIES/SERVICES FOR SALE

The excess satellite capacity provides four types of business opportunities or services that the RCTS licencee can sell: Downtime video transmission, In-B/MAC capacity, raw capacity and earth station services.

DOWNTIME TV TRANSMISSION

The most obvious piece of excess capacity is 'downtime' -- regional broadcasters don't use the overnight hours (midnight to 6am), since too few rural people stay up to make the time saleable. We sell this for video distribution, since 85% of our audience owns video recorders.

There are three main advantages to other video distribution systems, First, RCTS downtime signals can be made available to anyone in the applicable spot beam that has a television set. Second, because the B/MAC systems was originally designed for pay-TV and private networks, each receiver is individually addressable. Not only does this allow private networks, it permits them to be established ad-hoc, dissolved and re-established at will. Third, RCTS licencees have the exclusive access to the 30-watt beams, so any competition needs larger receivers than our 1.2 metre dishes to acheive the same ends.

IN-B/MAC CAPACITY

In addition to television signal, the B/MAC system carries teletext, four high-speed (204kbps) data channels, and a low-speed (9.6kbps) data stream.

B/MAC Teletext, unlike conventional teletext, requires no special decoder on the television set. Audience access comes automatically, as part of the satellite receiving system. It's an ideal advertising medium for companies that wish to sponsor timely information that the audience will check daily, such as weather, stock prices or specialized news tips. It's also ideal for companies on VIATEL, Telecom's videotext system, since our teletext puts PRESTEL technology in the homes of potential users for no-cost experimentation.

The data channels, again, have the advantage of being available at any 1.2 metre home satellite receiver. Since these receivers are also individually addressable, the in-B/MAC data capacity can be used for broadcast, private network or ad-hoc network applications. The high-speed (204kbps) data channels can also be used to provide 15kHz audio, suitable for high-fidelity radio, while the low-speed channel is ideal for one-way data requirement, such as database updating or tele-printing.

RAW (NON-B/MAC) SATELLITE CAPACITY

Fifty SCPC, or three 2-megabit, channels is not a great deal of capacity, but the ability to sell it off to reduce transponder costs will be crucial to the financial viability of the RCTS licencees. This capacity can be accessed from our network of 6.8 metre dishes around the state are also available for uplinking.

The most obvious use of this capacity is tele-conferencing. In conjunction with the public-switched telephone network, we are able to offer a unique one-way video/two-way audio service: the network can include any home satellite TV receiver as well as receivers on customer premises or in hotels.

This conferencing network can also be combined with the broadcast network for inter-active television: the audience can call up and participate in the show. We have already used this system for tele-stock auctions (selling sheep and cattle) and school-of-the-air (inter-active teaching via television), as well as the more normal business conferencing, including our own internal sales and management meetings. We expect this to be a major tele-marketing tool in Western Australian business.

EARTH-STATION SERVICES

GWN has established 6.8 metre earth stations in the larger towns where it was required to build retransmission facilities, although a 3.7 metre dish would have been adequate for receive-only installations. The reason for this excess capacity is that it will enable us to provide satellite tele-communication services to these communities long before it would be economical for Telecom (Australia's telephone company) or AUSSAT to do so. Our stations are designed as tele-ports or gateways for access to AUSSAT for use in a company's own private networks. It is this application which may run foul of Telecom's desire to retain monopoly control of Australia's communications net.

THE REGULATORY ENVIRONMENT

In general terms, there is a growing trend towards liberalization of telecommunications regulation in Australia. While far from the open slather of the United States, Australia is beginning to recognize at least in theory, that allowing greater competition can bring down the price and improve the efficiency of a system that is already fairly good by world standards. In proctice, however, the Telecom unions have put a stranglehold on even those few liberalization which Telecom management has been willing to accept. For example, although Telecom has recently decided to allow shared use of a PABX among different companies in the same building, the unions have said they will not maintain such PABXs nor connect any such PABX to the public network. This uncertian environment causes headaches for those companies who are operating on the leading edge of the system.

Most of the services that I have mentioned GWN is proposing to sell are on this leading edge of the Austalian communications regulatory environment. It has been suggested that each one of these services contravenes either all or part of Satellite Communications Act of 1984, the Radio Communications Act of 1983, the Broadcasting Act of 1942, of the Telecommunications Act of 1975, not to mention policies or regulations of the Minister of Communications.

NO RESALE OF CAPACITY

The conflict is due to the historical position of Telecom Australia as a quasi-public monopoly. To protect this monopoly from competition, no one else is permitted to operate their own public-switched capacity. To protect the monopoly from speculators, users are forbidden to resell communications capacity. That is, an operation such as GTE Sprint would not be legal, whether via Telecom lines or AUSSAT capacity. Indeed, it is theoretically illegal to let someone use your home telephone and then charge them for the call.

However, users are permitted to provide, and sell, value-added services. The difficulty come in deciding what is a value-added service and what is a resale of capacity.

We see the provision of B/MAC encoding as adding value to the system, and AUSSAT agrees. However, AUSSAT -- with a good deal of capacity yet to sell -- tends to be much more liberal in its interpretation of these rules than Telecom is. There is an obvious difficulty on the horizon if a customer wants to enter our value-added AUSSAT service via a leased line from Telecom.

NO THIRD-PARTY TRAFFIC

To ensure that the monopoly is fully protected, it is also forbidden to carry "third-party" traffic on a private network. Thus, in theory, it is illegal to let someone outside your firm talk over your private satellite, microwave or leased-line network, unless you can demonstrate they are member of a "common user group".

The common user group exemption is to allow communication between, say, subcontractors on a Woodside Petroleum private network for the North-west Shelf Natural Gas Project. It is also used to permit sharing of a surveilance network connecting, say, a group of unrelated businesses and a security company.

Unfortunately, common user group status is determined on a case by case basis, at the total discretion of the managers of AUSSAT and Telecom. That is, the telecommunications companies act as judge, jury and executioner on this issue. Thus, for the Queensland government satellite network, some deparments (eg. Police and Crown Law) were considered to be acceptable as a common user group, while others (eg. Public Health & State Education) were not.

Of course, television stations regulary sell time on their systems to third parties. While no one has even intimated that they might get so nasty, every commercial announcement could be seen as a third-party traffic. If we accept that as a ridiculous extreme, how do we classify paid broadcasts, such as religious programmes? If paid religious programmes are okay, along with our televised live-stock auctions, how does these programs differ from teleconferences for marketing and training?

Obviously, there is great room for negotiation, compromise and/or litigation. It is relatively easy for Q-NET, the Queensland government satellite network, to take on Telecom directly, but it is a bit more problematic for a small company such as ourselves, especially since we must lease video bearers from Telecom.

THEN WHY DID GWN GET INVOLVED?

Considering the potential financial difficulties and the strangling regulatory environment, it is legitimate to ask why the Golden West Network bothered to begin this enterprise in the first place, and you can be forgiven for thinking that we must not have known what we were doing.

The reasons for our decision are three fold: the Remote Community Television Service suits our social ideology, promises eventual profit and puts us on a learning curve which will take us to bigger markets in the future.

Our social ideology comes from 12 years as a local television operator in regional Western Australia. The kind of communication services we had to put up with, and the speed with which they were updated are a sore point with us and with many other rural businesses. We did not like being treated as second-class citizens, when it came to communications, and we don't think that there is any excuse for continuing to treat rural people that way in an age of distance-insensitive technology.

At GWN, we see the RCTS capacity as chance to build an integrated communications system that complements the monopoly common carriers. We have built a network of earth station in small communities, years before they can be available from the carriers. This network is accessible at a price far below that of a private system. We offer access to 30-watt satellite capacity to Western Australian users that will not otherwise be available until the second generation AUSSAT in 1992.

However, we are a commercial enterprise, not a charitable organization. Just as anyone who works for us, we expect an honest wage for an honest job. We expect to earn that wage by helping the region grow.

Western Australia is, geologically, one of the oldest regions in the world. It is not that the land is necessarily any richer in minerals than anywhere else, it is just that all of the covering rock and soil has worn away over the past few million years, so that the high-grade ores of iron, gold and the like lay on the surface ready to be mined with bulldozers. There are also significant off-shore deposits of oil and natural gas which are just beginning to be exploited.

Similarly, the tourism potential of Western Australia is nearly unlimited, with over 1000 miles of white sand beaches, crystal waters and a semi-tropical climate coupled with an undervalued dollar that means high purchasing power for the foreign visitor.

We are convinced that these factors, coupled with a modern communications infra-structure mean strong growth for our region. If we are right, we will do very nicely, if we are wrong we may lose our shirts.

Either way, we plan to learn a good deal along the way. It is an entry into the complex market of integrated satellite communication services which we plan to use as a springboard into the national and international marketplace. After all, if we can make money broadcasting television and providing telecommunications services to just 350,000 people in an area 1/3rd the size of the United States, we can make money anywhere.

If it is not presumptuous to close a paper with a piece of boastful advice:- Keep your eye on the Golden West Network ---- We're in your future.

Golden West Network

Getting the News to the Public in Truk: A Telecommunications Perspective

Eric H. Metzgar
UCLA Graduate School of Education

1. Abstract

As members in the emerging island nation of the Federated States of Micronesia, Trukese society is fashioning patterns of telecommunications use for tomorrow's society. This paper examines the social value of various telecommunications in serving the information needs of islanders in Truk. The data gathered suggests that whatever patterns of telecommunications use come and go, radio communications are likely to remain the medium of mass and personal communication par excellance.

2. BACKGROUND

Truk is a Micronesian archipelago of high volcanic islands encircled by a coral reef in the western Pacific. The reef, which encloses one of the largest lagoons in the world is 40 miles wide and about 120 miles in perimeter. The lagoon contains 11 major islands which support a population of approximately 40,000 people. Culturally and politically, Truk extends beyond itself and embraces many outer islands which, though separated in some cases by hundreds of miles from the metropole of Truk Lagoon, nevertheless "belong" to Truk. Hence, for the purposes of this paper, Truk includes not only the islands in Truk Lagoon but the outer islands as well. About 4,000 people live on these outer islands, bringing the total population to around 44,000.

Since the late 1970's, Truk has been in the throes of political transition from a district of the United States-administered Trust Territory of the Pacific Islands to a state in the newly-formed island nation of the Federated States of Micronesia (FSM). The other states in the FSM are the island groups of Pohnpei, Yap, and Kosrae. In 1983, the FSM voted in favor of a status that would grant them internal political autonomy from the US while guaranteeing annual financial assistance from the US in exchange for defense rights over the next 15 years. This new political relationship is called the Compact of Free Association between the US and FSM and was officially approved by the US in January, 1986.

Truk and other states in the FSM are small, lack resources, and have a 40-year history of dependence on US government subsidies to keep their economies going. There is every indication that this situation is likely to continue over the next 15 years unless dramatic economic development, heretofore neglected, can be successfully accomplished. Undoubtedly, telecommunications will play an important part in aiding economic development in the future. Moreover, telecommunications will play a significant role in molding social and political forces towards the process of nation-building and all that it implies as the FSM moves ahead with the Compact of Free Association.

The primary source of data for this paper is taken from a 1983 media survey conducted by this writer and 6 senior students from Xavier High School, Truk. The survey lasted 10 weeks and took place on Moen Island, capitol island of Truk State, which has a population of approximately 12,000 people. The results of the media survey were used by the students to produce a 45-minute video documentary entitled "Met Poraus? (What's the News?)" to satisfy a graduate requirement called the Town Study Project (1).

The secondary source of information was gathered in 1986 via letter correspondence through the generous assistance of Francis X. Hezel, S.J. at the Micronesian Seminar in Truk. This updated information is given after the results of the 1983 media survey are presented. Conclusions are then drawn when comparing the two sets of information.

3. OVERVIEW OF MEDIA SURVEY

Research in the 1983 media survey was directed towards answering the question, "How do people in Moen, Truk get the news?" Of particular interest was the degree to which books, newspapers and the like were used but this research focus did not exclude gathering data on other forms of media communications. On the contrary, it was considered necessary to survey all forms of media in order to evaluate the social value of print media in Trukese society. This same data is now being used to evaluate the social value of telecommunications in Trukese society.

"News" in the media survey was defined in a very broad sense as "information communicated via a multiplicity of forms." Using this definition, news might be communicated in a number of ways: it might be transmitted via a telecommunications medium such as a radio, television, or telephone;

it might be disseminated via other types of media such as a book, newspaper, or audiocassette; or it might even be communicated without the benefit of any form of media in the "old-fashioned" way—by word of mouth—as in a classroom lecture, church sermon, or a two-person conversation.

Three different types of data were collected in the media survey. The first type included physical evidence in the form of "media artifacts". A "media artifact" could be any "information storage and/or sending device" such as a book, map, calculator, clock, walkie-talkie, etc. Media artifacts were investigated in the home, business, and service (government and church) sectors on Moen. A total of 102 homes, 56 businesses, and 52 service agencies were surveyed using checklist observations of the various types of media found in each of the three research sites.

The second type of data collected included media communications used by a cross-section of 100 Trukese citizens. Informants were asked to respond to a list of questions concerning the types of media they used and whether they used them 1) everyday, 2) almost everyday, 3) at least once a week, 4) not very often, or 5) never. In addition, informants were asked how they learned about the results of the recent election for governor of Truk State and how they got the news about the cholera epidemic which had broken out on Moen only three months before the survey began.

The third type of data collected included media communications used by the government of Truk State to educate the public about the Compact of Free Association. Truk State set up a Public Information Program (PIP) to carry out an education campaign in January, 1983. The public vote on the Compact was scheduled to take place in June-six months later-and voters were asked to either approve or reject the Compact (2). The activities of the PIP afforded the media survey team an unique opportunity to collect information on what kinds of media were being used by the government of Truk State to educate the public on the details of the Compact.

4. RESULTS OF THE MEDIA SURVEY IN TERMS OF TELECOMMUNICATIONS

The first set of data concerning media artifacts found on Moen revealed the following information. Less than 10% of the general merchandise stores in the downtown area sold newspapers or magazines, nearly all of them sold radios. The radios were used by the public to listen to Truk's one and only radio station—WSZC "Voice of Truk"—which had been owned and operated by the government since 1962. The only other types of telecommunications equipment for sale to the public were walkie-talkies and one television set. The lone television set was left over from an earlier "TV boom" period in 1980 when Truk's first television broadcast station—WTKK—went into operation (3). The WTKK-TV broadcasts proved to be a short-lived business venture, however, because the privately-owned station went bankrupt between 1981 and 1982, about a year and a half after it started. The reason given by the owners for the demise of WTKK-TV was that the station's signal strength was limited to Moen. As a result, WTKK-TV could not reach the other islands in Truk Lagoon and the number of subscribers who had bought TV sets on Moen were not enough for the station to make money. There was also a problem with operating the TV sets and VCR's on the other islands because only Moen had government power. Only the families that had their own gasoline-powered electric generators could watch TV. In contrast, transistor radios could be powered with batteries.

After WTKK-TV stopped broadcasting, 1/2" videocassette recorders (VCR's) started to come into Truk to fill the void in entertainment programing. A huge videocassette recorder club came into being with individuals circulating American and Japanese-produced videotape programs informally among themselves and occasionally renting programs from the stores that went into the business of renting videocassettes (4). No VCR's, however, were for sale in the stores during the time of the media survey. It was assumed that those persons who had TV sets had already bought a VCR or were waiting in the hope that WTKK-TV would resume broadcasting so they would not have to buy a VCR.

All the government agencies and private businesses in the downtown area had telephones but very few homes had telephones. The telephone system was government-owned and operated and could only handle 800 telephones, all of which had been installed long ago. Plans were in the making to buy a new system with a capacity of 2,000 telephones which would interface with the COMSAT (communications satellite) station that was scheduled to begin operating in May, 1986. At the time of the survey, telephone calls outside of Truk had to be routed through Saipan, an island northeast of Guam about 800 miles from Truk. The telephone lines to Saipan were almost always tied up, and even if one were able to get through, the quality of the connection was usually very poor. With the COMSAT station in operation, telephone users looked forward to getting their calls placed day or night with better quality sound.

The second set of data dealing with Trukese use of media communications revealed the following information. Nearly 90% of the informants interviewed said that they listened to WSZC-Radio everyday during some part of the day or night. When asked how informants learned about the results of the election for governor of Truk State, 90% said they found out from listening to the radio. When asked how they learned about the cholera epidemic in Truk, 50% said they heard about it from the radio, the other 50% heard about it from a friend or neighbor.

Only 25% of the persons interviewed said that they never watched TV. These persons were generally over the age of 35. Approximately 20% of the informants stated that they watched TV everyday. The members of this group were largely under 35 years of age.

The last set of data from the media survey revealed what kinds of media communications the Truk government used to educate the public about the Compact of Free Association. Given the short amount of time before the scheduled voting day--only six months away--the government chose to invest the majority of its resources into two areas: 1) oral instruction in the form of task-force teams sent out to talk face to face with the public about the Compact, and 2) development of a radio program series on WSZC. Printed copies of the Compact document were available in English and Trukese at the Truk State Public Information Program Office but were not distributed to the general public or seen in any of the stores. One of the reasons given in favor of sending task-force teams to discuss the issues of the Compact with the public was that the outer islands had trouble receiving the WSZC-Radio signal on their battery-powered transistor radios. The government could, however, keep in contact with the islands in Truk Lagoon and the outer islands via 2-way high frequency radios which were monitored at scheduled times of the day and/or week on each one of the inhabited islands. Church organizations, too, had their own CB radios to keep in touch with priests and ministers at their missions on Moen and the other islands.

There was a problem, however, with operating these 2-way radios on the other islands since only Moen had government power. In order to operate a 2-way radio on the other islands in Truk Lagoon or the outer islands, electricity was either provided by small gasoline-powered generators or storage batteries which were recharged by photovoltaic cells. Either way, these 2-way systems periodically failed because of wear and tear and the high level of humidity which tended to corrode electrical connections. From the point of view of outer islanders, who are hundreds of miles away from Truk Hospital, such failures sometimes had tragic consequences since radio communications were the only means that outer islanders had of calling for help in the case of a medical emergency.

5. TELECOMMUNICATIONS UPDATE

In 1986, a private radio broadcast station--WSCB--owned by the Evangelical Church of Christ, began operating on Moen. It is the only other radio station in Truk besides WSZC-Radio.

Since WTKK-TV stopped broadcasting in 1982, it has never resumed operations nor has any other TV station attempted to go on the air. As a result, the VCR "revolution" continues unabated.

No new telephone system appears to have been installed in Truk. The telephone lines have never progressed as far as government power even though the intention in 1983 was to increase the capacity of the system from 800 to 2,000 telephone units. Consequently, there continues to be a long waiting list for phones. COMSAT is still in business but it may be losing money. In order to cut losses, COMSAT sent many of its American personnel on to other places. COMSAT has, however, been interfaced with the old phone system. The cost for placing calls outside of the FSM remain high--$3 a minute with no reverse charges allowed and nothing done on credit.

6. CONCLUSIONS

From the evidence presented, we see that some forms of telecommunications are used more regularly by the general public than others. Compared with television and the telephone system, transistor radios, 2-way radios, and walkie-talkies are by far the most widely used forms of telecommunications. We have seen that the experiment with WTTK-TV in Moen failed and was never revived; and though VCR's are popular with perhaps 20% of the population, this fact hardly compares with 90% of the public that listens to WSZC-Radio everyday. Moreover, videocassette shows in Truk are largely American or Japanese-produced with most programs of the entertainment variety. Little in the way of locally produced videocassettes are being produced, whereas both WSZC-Radio and WSCB-Radio are locally produced and carry local news. We have also seen that telephones mainly serve the interests of government agencies and private businesses located in the downtown area of Moen. Their use by the general public in Truk is severely hampered by the 800-unit capacity of the system and the fact that government power is not available on any of the other islands besides Moen. There are no phone booths on Moen. Those who do not have access to government or business phones and who reside on Moen can, however, visit the COMSAT station to place calls.

The above information suggests that radio communications are highly valued in Trukese society. And when compared with data on non-telelcommunications media, we see that radio communications are more valued than any form of print media. For instance, only 10% of the general merchandise stores on Moen sell books, magazines or newspapers to the public whereas radios abound. When compared to non-media, however, radio communications appear to be no more important than word of mouth, face to face communications. For example, 50% of our informants said that they learned about the cholera epidemic from listening to the radio, but the other 50% heard about it from a friend. And the Truk State education campaign on the Compact placed just as much value on face to face group meetings with villagers as with the radio series broadcast over WSZC-Radio. Can this be? Very likely so. Let us not forget that regular telecommunications by Trukese for Trukese is a comparatively recent phenomenon only dating back to 1962. By and large, Truk is still an oral culture that relies on traditional methods of information exchange through face to face communications. Given this perspective, it is not surprising that radio communications with its reliance on oral/audio transmission of news and information through speech, song, and music should find a welcome niche in Trukese society. Nor is it surprising that radios rather than telephones or television sets should be the most used form of telecommunications. They are relatively inexpensive, can be battery-powered, and are ideally suited for communicating between islands separated by water.

A case may be argued for expansion of the telephone communications system but the cost seems to be prohibitively expensive, even on Moen itself; and Moen has government power whereas the other islands have no source of constant power.

A case might also be made to try and revitalize broadcast television, but the costs are conservatively estimated at five times that of radio. Also, one still runs into the problem of operating television sets on islands where lamps and refrigerators are commonly powered by kerosene, thereby limiting the majority of broadcast television subscribers to Moen. And this, as we have seen through the experience of WTKK-TV, is more or less a non-profit situation worthy only of government intervention. There is, possibly, another way of expanding the information potential of TV in Truk by producing local programming on videocassettes--perhaps through the Truk State Public Information Program Office. The videocassettes produced could then be distributed for free or at a nominal cost through stores that now rent entertainment videocassettes to the public. Such an effort might have an impact over the long-term because persons who generally have access to and can afford television sets are most likely to be "opinion leaders" in Trukese society. "Opinion leaders" lead the way in setting trends and attitudes that later become accepted by the public at large.

All in all, the evidence presented in this paper suggests that radio communications will remain the number one choice of telecommunications in getting information to both the mass population and to private individuals in Trukese society, with telephone-COMSAT second, and television-VCR's a distant third. Until such time as government power becomes available to other islands in Truk besides Moen, this pattern of use is not likely to change; and with the constraints of limited financial assistance provided by the US to the FSM through the Compact of Free Association over the next 15 years, the people of Truk State will be hard pressed to maintain let alone increase what telecommunications services they now possess.

7. FOOTNOTES

(1) The Town Study Project at Xavier High School, Truk was designed to be an in-depth study of a phenomenon or issue in Trukese society. In the late 1970's these projects ranged from written reports which were published in the Micronesian Reporter to radio programs which aired over WSZC-Radio "Voice of Truk", to other video documentaries seen on videocassettes in Micronesia and the United States. More information is given on TV production at Xavier High School in an unpublished paper by the author entitled, "TV in Truk: An Experimental Curriculum." (1984)

(2) The Truk, Yap and Kosrae legislatures approved the Compact, fulfilling the FSM constitutional requirement that it be ratified by three of the four states. In a June plebiscite, 79% of the FSM voters approved the Compact, though 51% of the Pohnpeians voted against it.

(3) For an incisive analysis of how broadcast television was introduced into Truk and other islands in the FSM, see Helen Hill's article, "Horseless Carriage and Cracked Mirror: the Electronic Media in the Pacific Islands." (Media Information Australia, No. 23, pp. 17-27, 1982). Also, Dennis O'Rourke's film, "Welcome to Yap" (Australian Film Commission and WGBH Boston, Massachusetts, 18 page manuscript, 1980) examines the social controversy surrounding the introduction of a government-owned and operated television broadcast station in Yap, FSM.

(4) Joan King's article, "Television or VCRs on Ponape?" (Pacific Island Communication Journal. 13:2, pp. 53-57, 1984) describes a similar development with VCR's on Pohnpei after KPON-TV had technical problems with broadcasting programs and collecting subscription fees. She also gives an insightful rationale for why Pohnpeians seemed to be opting for VCR's rather than broadcast television shows: "Watching tapes rather than television solves the problem of having to deal with television programs and commercials with sexual overtones, which many Pohnpeians find inappropriate and offensive."

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Australia Pioneers B-MAC for Television Broadcasts by Satellite

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1. Abstract

A significant aspect of the recently commissioned satellite broadcast services of the Australian Broadcasting Corporation (ABC), involves the pioneering use of the new television encoding system known as B-MAC. The B-MAC system allows the ABC to transmit both television and radio programs within the same signal, via the new Australian domestic satellite to remote unserved areas of Australia.

1. Introduction

Over the past twelve months the ABC has commissioned a comprehensive range of satellite broadcast services. At the end of 1985 for the first time, the ABC provided a truly national service when the first broadcasts of ABC television and three of its radio networks were made from the newly commissioned Australian Domestic Satellite System, Aussat. Although the level of service was not designed to meet the full criterion for strict DBS, the broadcasts do provide a level of quasi DBS which is cost-effective and serves the needs of the remote areas of Australia. It should be remembered that Australia has a comparatively small population scattered across a huge continent, which makes terrestrial methods of broadcasting impossibly expensive, particularly for the remote rural inhabitants. It is estimated that 300,000 people are outside of the terrestrial coverage of ABC television and radio. The satellite is used to transmit television and radio signals into five separate zonal beams which can be received directly by remote area residents, and are used to feed the ABC terrestrial transmitters.

2. B-MAC

This remote area satellite broadcast service of the ABC's is called HACBSS (Home and Community Broadcasting Satellite Service) and uses a new method of transmitting the television and radio signals to the receiver called B-MAC. As such the ABC HACBSS service has pioneered internationally the use of this advanced television encoding technique replacing PAL which is used within Australia for terrestrial television transmission.

The B-MAC television system, in addition to providing two audio channels for the television program, is able to "piggy back" four high quality audio and/or data channels in a similar way that Teletext data is carried within the television signal. It is in this way that the ABC is able to transmit three of its national radio networks to all HACBSS receivers together with ABC television.

As well as providing a direct-to-the-home service to remote users, the ABC HACBSS transmissions are used to feed regional television and radio transmitters. This has allowed much of the extensive terrestrial transmission distribution network to be relinquished with significant cost savings.

3. MAC Standards

There has been much discussion and debate over the MAC encoding technique particularly in Europe where two versions, C-MAC and D2-MAC, will be used for their satellite services. All of the MAC systems have similar basic vision parameters but beyond that they differ in significant details in their sound and data facilities.

MAC is an acronym formed from "multiplexed analogue components" which describes the system in technical terms. In the MAC system the luminance (back and white) and the colour components of the signal are transmitted sequentially during a television line period and reassembled at the receiver. In the PAL system the colour information is carried on a sub-carrier within the luminance signal. The colour is extracted from the luminance signal in the receiver.

The MAC encoding system is able to achieve improved technical quality compared with PAL and other earlier encoding techniques. Because the two components of the colour television signal (luminance and colour) are kept separate in MAC, they are not able to interact and cause what is known as cross colour degradation and loss of fine picture detail. Thus the colour definition and picture detail can be somewhat sharper in a MAC signal compared with PAL. Another improvement is the reduced visibility of noise in the colour signal because of the absence of any high energy sub-carrier at the upper end of the television signal which can cause noise particularly in satellite transmitted signals.

MAC requires that the signal at the receiver be stored on a line by line basis and time expanded before reproduction on the screen so that both luminance and colour component signals occupy the full line period. Such systems were not practical for consumer equipment a few years ago because of the lack of low cost signal storage systems. Modern integrated circuit techniques have overcome this problem.

The prefix "B", "C" or "D2" designates the particular method of carrying the audio signals. The "B" system that Australia has adopted provides for six high quality audio channels using a digital delta modulation technique developed by Dolby.

These are carried by a digital modulation method in the line blanking period of the television signal. The line blanking period is unused time between the end of one line and the beginning of the next provided so that receivers can commence the new line aligned to the picture tube margin.

In Australia the B-MAC sound channels are used as follows:

	No of Channels
Stereo sound for television	2
Radio 4 stereo (ABC FM)	2
Radio 2 (ABC Radio National)	1
Radio 3 (ABC Regional Radio)	1

4. The Choice of B-MAC

Australia had to choose a satellite transmission system in the very early days of MAC development. The selection of one of the MAC family was made in order to meet the objectives of the planned ABC satellite service, which was to provide not only ABC television but also three ABC radio channels to all areas of Australia in the most cost effective manner. The decision to provide radio satellite services as well as television was based on a survey which indicated the people in remote areas placed a high priority on radio as a possible service from the satellite.

At that time, direct satellite broadcasting of television had been done experimentally using the normal transmission standards. Therefore it was proposed to use a standard PAL signal. For radio it was intended that individual channels should be used for each service. This was to allow the ABC to uplink the sound channels independently of television, allowing full operational felxibility. Therefore a design was proposed for a "single channel per carrier" (SCPC) system with five independent carriers in the one 30 watt transponder. One carrier would carry TV and would require most of the power and bandwidth. The remaining smaller carrier would provide four sound channels which would provide two mono services (Radio 2 and 3) and one stereo service (Radio 4).

This scheme, although attractive because of its operational flexibility, suffered from a number of problems. The first to become apparent was that provision of all the radio services would compromise the performance of the television signal. Eventually in order to have adequate TV performance, it was considered necessary to limit radio to only two channels. A second problem was that that the performance of the radio channels, at least as received on the individual earth stations, would never be better than mediocre. Because of the poor frequency stability of domestic grade equipment operating at the satellite frequency, a special receiver would be needed. Manufacturers were not prepared to provide these receivers at reasonable cost.

As well as the inherent improvements in colour quality possible with the new MAC encoding technique it was expected that the B-MAC signal would be more resilient to interference and would produce higher quality service than PAL under adverse transmission conditions caused by rain or by electrical disturbances.

In September 1984, when the Australian Government selected B-MAC and specifically the Scientific Atlanta version (ie: SA-B-MAC) as the national satellite transmission standard it was understood to be the only MAC standard that could be produced in sufficient quantities to allow a public service to begin in the last quarter of 1985.

5. Performance to date

Compared with the design objective of $1,000 per installation, (at 1980 prices), the final cost to users of a HACBSS receiver and antenna was typically $2,500 when services began in 1985. This includes a 1.5m dish which is the size required in most remote areas. In some locations towards the edge of each footprint a larger dish of 2.2m or 2.8m is required.

The market penetration of B-MAC receiving equipment has been slow so far but this is expected to increase later this year when the first of the Remote Commercial Television Services begin. It is planned that each footprint region in Australia will have a commercial satellite service as well as the ABC one.

The technical performance has so far met the expectations at the time of selecting the standard and the HACBSS service has proven to be capable of very high quality.

Most of the terrestrial television and radio transmitters formerly fed from long microwave links have been cut over to be fed from receive-only-earth stations via the HACBSS signal. As a result a worthwhile improvement in picture quality has been noticed in may areas of Australia. In addition the old system of feeding remote regional transmitters via an Intelsat transponder has been replaced by using the HACBSS signal through further receive-only earth stations.

Significant offsets to the cost of operating the HACBSS service has been realised in that one of the zonal footprints, the south eastern, provides coverage of all the state capital cities except Darwin. The HACBSS signal from this footprint is therefore used for program distribution from

Sydney to the state capitals it covers. With this capability from the satellite it has been possible to restructure ABC television operation by concentrating more on national networking and by abandoning the physical syndication of program material on videotape to all operating locations. This has achieved further cost savings.

As well as the quasi DBS services described so far the ABC is making considerable use of the satellite for program interchange between its radio and television operating locations throughout the country. This use involves a comprehensive system of up and down links, together with one satellite transponder for radio and two for television. In the capital cities the ABC utilises Aussat's earth stations but in regional areas the ABC will be installing its own earth stations at its radio studios.

6. B-MAC Management System

The Scientific Atlanta B-MAC system was developed as a television transmission technology optimised for direct-to-home "pay" television services. A fundamental component of the design is a conditional access capability. This allows independent and individual authorisation of the television, radio, teletext and data services that make up the composite B-MAC signal. The ability to selectively control access to services is determined by the status of service authorisation information transmitted by the broadcaster and stored within the B-MAC decoder in each receiver. If decoders have been authorised for a particular service or services, then they will only process those signals for reception. Access to other services is barred.

Although the ABC does not currently make use of these "pay" facilities, it was agreed that the possibility of utilising the conditional access capability at some time in the future should be taken into account in introducing the new satellite services. If this were not done from the outset it would be virtually impossible to do it at a later date. Also it is envisaged that B-MAC will be used not only by broadcasters but also by various organisations for a variety of satellite distribution purposes that may not be intended for reception by the general public.

Accordingly a data base of all B-MAC receivers sold within the country has been established. This is maintained by the ABC. So far, with the number of receivers involved this has not created any significant problems, however, it is acknowledged that maintenance of an accurate data base for a "free to air" public broadcasting service over a long period of time will be difficult.

To establish the potential use for, and to maintain effective use of the conditional access system requires a considerable degree of co-ordination and co-operation between B-MAC operators in order to prevent service authorisation conflicts.

While the technology offers some degree of sophistication to help eliminate such conflicts, there is a need for a system management framework. This framework has been established by the Government's Department of Communications in consultation with the ABC and other potential users and is called the B-MAC Management Plan.

7. Conclusion

The ABC has pioneered the introduction of a very substantial satellite radio and television service over the past twelve months, utilising B-MAC technology to provide an appropriate cost effective broadcasting service to previously unserved areas of the country.

B-MAC was chosen because it was the best available option for providing radio as well as television services. The performance so far has demonstrated the high picture quality inherent in the improved television encoding technique. So far, the ABC has not planned to use either the data communications, nor the selectable access capability of the B-MAC system. However, potential applications are being considered.

SESSION 3

Shared Tenant Services and Teleports— A Videoconference Discussion

ONE PERSPECTIVE ON DIGITAL VIDEOCONFERENCING, SHARED TENANT SERVICES, THE DEMAND FOR TELEPORTS, AND STATE REGULATION

by

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ABSTRACT

This paper addresses several topics that may seem to be only loosely related. Digital videoconferencing, shared tenant services, teleports, and state regulation are interrelated, however: increased use of digital videoconferencing, available in an intelligent building either intracorporately or as a service provided by a landlord or other third party, will require high-speed data circuits; high-speed data circuits, when available, are often available only from a teleport. Such teleport services depend, however, on state regulatory agencies' permitting shared tenant services and/or bypass of the local exchange company. This paper surveys the developments that have led to a groundswell of cases decided or being decided before state regulatory agencies concerning shared tenant services and bypass, and the effect such decisions will have on the development of videoconferencing.

INTRODUCTION

Digital videoconferencing, shared tenant services, teleports, and state regulation are interrelated: increased use of digital videoconferencing, available in an intelligent building either intracorporately or as a service provided by a landlord or other third party, will require high-speed data circuits; high-speed data circuits, when available, are often available only from a teleport. Such teleport services depend, however, on state regulatory agencies' permitting shared tenant services and/or bypass of the local exchange company ("LEC"). Or, to phrase the premise rhetorically and from a marketing perspective, what will dramatically increase the growth of telecommuncations traffic among business, especially international business, users? More voice circuit usage? More microcomputers passing files at 1.2 or 56 kbps? More telecopiers? More audioconferencing? Yes, to all of those, but nothing approaches digital videoconferencing as a potential consumer of high-speed data circuits, especially among different corporations. Other digital applications that require high-speed data connectivity can be substituted for videoconferencing in this model, but it is digital videoconferencing that probably offers the most potential for the growth of high-speed data traffic between users that are not members of the same business entity. For instance, it would be rare for two mainframe computers operated by unrelated corporations, especially in different countries, to require several hours of connect time at 1.544 mbps; it would be entirely normal for an international videoconference to last several hours at that data rate.

High resolution digital videoconferencing requires access to a T1 (1.544 mpbs in the U.S.) channel; data rates between 56 kbps and T1 either are not available or are too expensive compared with T1 service. A T1 channel must come either from an LEC or from a teleport operator. (Teleport shall mean a teleport not owned by a regulated LEC; ownership of a teleport by an unregulated entity related in some way to a regulated LEC should be equivalent for purposes of this analysis to a non-LEC teleport.) State regulatory agencies, specifically public utilities commissions or a public service commissions, have within their jurisdiction the granting of certificates of public convenience and necessity ("CPCN"), denoted simply as certificates of public convenience in some states, to persons that own, lease, or manage telephone facilities that offer service to the public. Any person that has offered a T1 channel for use by the public within a state invariably has been required to obtain a CPCN. Thus, state regulatory decisions, by controlling the certification of shared tenant services and of T1 offerings that bypass the LEC, will shape the growth of digital videoconferencing in the U.S.: the slowest growth will be if only LECs are permitted to offer T1 service; if state regulators permit LECs and entrepreneurs like teleport operators and teleport service resellers to offer T1 services, the resultant competition will spur faster growth of digital videoconferencing and other T1 applications.

A COMPRESSED VIEW OF DIGITAL VIDEOCONFERENCING

Full-motion, color, digital videoconferencing ("digital videoconferencing"), for practical purposes, is a development of the 1980's. In contrast, full-motion, color, analog videoconferencing ("analog videoconferencing") is as old as the television anchorperson posing questions to a correspondent at a remote site, that is, at least ten years old. Analog videoconferencing is very expensive: each side of a two-way analog videoconference requires a full transponder on a satellite. A transponder normally can carry hundreds of voice circuits; a two-way analog videoconference between two sites, that is, a "two-node interactive" videoconference, thus consumes the capacity of over a thousand telephone calls. Analog videoconferencing has been, is, and will stay expensive and the province of television networks, governments, and Fortune 1000 corporations.

Because of expense, most videoconferencing to date has been of the "telepresentation" type: one-way video, two-way audio. Telepresentation videoconferencing, however, is inadequate for applications where the interactive ("real-time") exchange of visual information is important. Prior to the development of digital videoconferencing, meeting planners had no economic alternative to telepresentations. Digital videoconferencing offers that alternative.

One form of digital videoconferencing that can "fit" in the same space as a single telephone circuit, known as 56 kbps video, costs approximately $300 per hour for a coast-to-coast connection. Video codecs (codec is a contraction of "coder-decoder") that operate at 56 kbps are currently available; dial-up networks for 56 kbps, for instance, AT&T's ACCUNET 56 Service, are also currently available in several metropolitan areas. Although 56 kbps videoconferencing equipment operates in a duplex (each node alternates transmission over a single circuit) mode and is in color, the coding algorithm necessary to reduce the transmitted data rate to 56 kbps (only 1/1440 of the original video information is transmitted) produces blurred motion. Such blurred motion is adequate for many business meeting purposes, but is inadequate for applications where "reading" the facial expressions of the remote participants is critical. Higher data rates are the answer to the blurring problem. Higher data rates, however, are not currently available on a dial-up basis, but must be pre-arranged.

Arrangements for the standard high-speed data circuit, a T1 circuit, are relatively straightforward to make and competitively priced if the user can be served by a teleport, and often very difficult to make and expensive if service is not available from a teleport. (However, within the next decade, dial-up T1 services similar to AT&T's ACCUNET T1.5 service may be widely available.) Access to one or more T1 channels permits the use of high-speed digital videoconferencing. The best video codecs can operate at data rates from 384 kpbs to 1.544 mbps. Higher data rates provide higher resolution and better depiction of motion. Full-featured video codecs, such as the Compression Labs Inc. Rembrandt, can perform television standards conversion, sense the data rate provided to the codec by the network, and lock to the maximum available data rate automatically. The growing capabilities of video codecs, especially the ability to operate within that part of a T1 channel not being used for voice or computer traffic, are helping to create a demand for T1 services.

THE EFFECT OF STATE REGULATION ON THE GRWOTH OF SHARED TENANT SERVICES AND TELEPORTS

One of the largest markets for T1 services lies in shared tenant services. The ability of building owners or lessors to package telecommunication facilities, such as digital videoconferencing, enhanced voice circuits and messaging, centralized word processing, security, etc., just as they have traditionally packaged electricity, unheated water, chilled water, sanitary sewer, and other building utilties for tenants, helps building owners or lessors attract lessees, especially smaller lessees who could not afford such a calibre of service were it not for shared tenant services. To be profitable to the building owner or lessor, the provision of shared tenant services normally requires one or more T1 channels between the building telephone switching equipment and the satellite uplink or fiberoptic cable terminus (normally, the LEC or a teleport). It is often economically desirable to obtain a teleport connection by bypassing the LEC. Thus, shared tenant services generally and digital videoconferencing specifically may not be economically feasible without bypass.

Both shared tenant services and bypass of the LEC require approval by the state public utilities commission, either by a declaratory judgment that the public utilities commission has decided not to regulate shared tenant services and/or bypass, or by certification on a case-by-case basis. Approximately ten state public utility commissions have reached decisions concerning shared tenant services or bypass. The trend appears to be that the commissions permit one or both, and often with greatly reduced regulation. Some states, however, have prohibited shared tenant services based on a finding that the LEC has a monopoly that must be preserved to ensure "universal service" to telephone subscribers. The commissions fear the teleports and shared tenant services operators will "cream-skim" and leave the LEC with unprofitable residential subscribers. Other states have decided that high-speed data circuits are different enough from local telephone service so that competition will provide better regulation of pricing and quality than the government. A corollary of the last view is that building developers "created" new business subscribers that were not previously available to the LEC, therefore the LEC could not be damaged if bypass of the LEC and the institution of shared tenant services were permitted.

In conclusion, this paper has outlined the interrelationship of digital videoconferencing, shared tenant services, the development of teleports, and state regulation. For those unfamiliar with one or more of the subject areas, the author hopes that this discussion has made the interrelationship clearer.

SESSION 4
Using Information Systems

Some Experiences in the Field Trial of Videotex Service in Taiwan

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Abstract

By integrating the technologies of computer, telecommunication, and television, videotex service emerges nowadays as a new important medium in an information society. The first stage construction project of the Chinese Videotex System (CVS) was finished in August 1985 and followed by a two-year field trial service offered to the public. This paper will present the experiences gained in this challenging field. First local environment is explained and the results of market surveys is given. Then the strategies to implement the public service is outlined. Next we briefly describe the results in the field trial during the previous fifteen months. Finally future plans to satisfy the public needs is included.

1. Introduction

Taiwan is an island with limited natural resource. It is about the same land area as the Netherlands, but much of the territory is mountainous with low economic values. The population is near 20 millions, while a significant portion is concentrated along the western coast.

During 1970's, Taiwan telecommunications did enjoy the world's fastest growth rate in basic telephone service (e.g. Mean annual increase is 22.3% in 1969-1978). Today Taiwan has about six million telephone sets in operation, which provide a telephone penetration of more than 30 telephones per 100 population. The supply and demand of telephone service are now in good balance.

Since 1980, the government has spent a lot of efforts to dovelop information technology and industry. This country has put the top priority on the execution of Science Technology Development Program, in which information has a very significant place.

Data communications development provides a very important infrastructure for the coming information age. It is one of the most decisive factors for a country to keep in the front end of information society. The establishment of the state-of-the-art technology in the related areas becomes quite a challenging task at the present stage.

This paper presents some experiences learned in the development of a public videotex service in Taiwan, called CVS (Chinese Videotex System). We first explain the local environment and give the results of market surveys. Then the strategies to implement the public videotex service is outlined. Next we briefly describe the results in the field trial during the previous fifteen months. Finally future plans to satisfy the public needs is included.

2. Local Environment

Videotex is a typical example to integrate computer and communication areas. The maturity of these two areas in local market has a significant influence on the timing to introduce the videotex service. In the following sections, some statistical figures is provided for reference.

2.1 Computers

In Taiwan, the first computer was installed in 1962. During the early days, computers are so expensive that almost only government and educational institutes could afford them. After the introduction of minicomputers, the prices did attract more and more private industry and business to computerize the administration and operations.

According to the statistics, the average annual growth rate of total installations of computers (exclude microcomputers and personal computers) from 1971 to 1985 reaches 33%. Among 2298 computers installed by June 1985, the distributions are as follows:

Large-scale computers	94	Systems
Medinm-scale computers	141	Systems
Small-scale computers	895	Systems
Mini-scale computers	1168	Systems

So far as information industry is concerned, the 1985 export value is more than 1.2 billion U.S. dollars. Among them, micro/personal computers, floppy disk drivers, printers, terminals, and monitors are major items.

Computer education programs have been strongly emphasized in order to provide enough qualified computer-related human resource. Besides B.S., M.S., and Ph. D. programs, professional education/training programs are also greatly enhanced.

2.2 Data Communications

Due to the extensive developments of modern data communication technology in the past five years, many data communication systems have been set up to provide different kinds of public services.

According to the new data communications regulation, which was approved by Ministry of Communications and enacted on May 15, 1986, the scope of data communication services includes:

(1) Data leased circuits.
(2) Packet switched data network (PSDN).
(3) Circuit switched data network (CSDN).
(4) Dial-up service.
(5) Universal databace access service (UDAS).
(6) Public information processing system (PIPS).
(7) Message handling system (MHS).
(8) Videotex.
(9) Teletex.
(10) Local area networks.
(11) Specific information networks.

The following three examples are used to illustrate the fast market growth in this country:

(1) Total number of data leased circuits in service:

Dec. 1971	The service was inaugurated
Dec. 1980	642 lines
Dec. 1984	3329 lines
Dec. 1985	4452 lines
July 1986	5276 lines

(2) Total number of dial-up subscribors:

Jan. 1984	The service was inaugurated
Dec. 1984	180 Subscribers
Dec. 1985	600 Subscribers
July 1986	1063 Subscribers

(3) Total number of packet switching subscribers:

Oct. 1984	The service was inaugurated
Dec. 1984	17 Subscribers
Dec. 1985	73 Subscribers
July 1986	465 Subscribers

One thing which may be worth mentioning is that all data communication services except data leased circuits are available to the public after 1981, the year in which Data Communications Institute was established.

3. Market Study

Videotex provides a new medium for mass communications. It is quite important to conduct a comprehensive market study such that the insight of customer behavior can be better understood. The following are some results of market surveys which were done by the National Cheng-Chi University one year ago (1).

3.1 Information Providers

This part of work was done by selecting 156 potential information providers and visiting them personally to collect the answers of well-prepared questionnaire covering four areas: background, videotex awareness, possibility to be an information provider, and present status on information demand. Major results are summarized as follows:

(1) The top three classes of information to provide are:
   (i) Product catalog
   (ii) Government announcement
   (iii) Trading opportunity

(2) The preferable way to store information is:

Storing in videotex center	35.4%
Storing in external detabase	59.9%
Both places:	4.7%

(3) The reason to provide information

For advertisement and sales	65%
For profits	24.7%
Others	10.2%

3.2 Non-resident Customers

This part of work is done by visiting 448 companies and organizations. The sampling space covers the customers shown on the yellow-page telephone directory having at least five telephone numbers in Taipei and four telephone numbers in Taichung and Kaohsiung cities. The questionnaire for non-resident customers includes five areas: background, present states to acquire information, videotex awareness, possibility to be an information provider, and possibility to be an information consumer.

The following give major results:

(1) 53.6% of samples know what the videotex is, but only 14.5% have the clear picture. Newspapers and magazines are two major media for the public to obtain the videotex concept.

(2) The first three classes of information on demand are:
   (i) Product catalog, Business directory.
   (ii) Market surveys, Consumer report.
   (iii) Trading information, Bidding information.

(3) 24.2% of samples also consider to be an information provider.

(4) The ranking by assessing the relative importance of videotex functions are:
   (i) Information retrieval
   (ii) Message exchange
   (iii) Transaction
   (iv) Closed user group
   (v) Telesoftware

3.3 Resident Customers

This part of work is done by visiting 496 resident customers. They are sampled at random from Taipei resident telephone directory. The questionnaire for the resident customers include three areas: background, present status to acquire information, and videotex awareness and potential to be an information consumer.

The findings are given as follows:

(1) The rankings of information usefulness are:
   News/weather forecasting
   Health/nutrition
   Government announcement
   Tourism information
   Shopping/sales
   Athletics/games
   Publication/books
   Transportation
   Cultural/arts activity
   Job opportunity

Stock/finance

(2) Only 34.1% of samples know what the videotex is, and only 8.7% have the clear picture.

(3) The ranking by assessing the relative importance of videotex functions are:
(i) Information retrieval
(ii) Transaction
(iii) Telesoftware
(iv) Message exchange
(v) Closed user group

(4) 49.6% of samples are possible to be an information consumer.

(5) 56.6% of samples are willing to pay under NT$500 per month (US$1=NT$37).

4. Implementation Strategies

4.1 NAPLPS Standard

According to CCITT recommendations, three basic approaches are possible to provide the videotex service:

(1) Alphamosaic approach
(2) Alphageometric approach
(3) Alphaphotographic approach

The second one is more attractive to us based on the following main considerations:

(1) It is easy to create the strokes of Chinese characters in graphical mode.
(2) 1200 bps data links are enough to transmit videotex frames.
(3) Local electronic industry is well developed and hardware prices become cheaper and cheaper.

Therefore NAPLPS (North American Presentation Level Protocol Syntax) standard is adopted in our implementation.

4.2 Bilingual Capability

Although the English language is very popular in this country, Chinese is still much welcomed by the majority. So the bilingual capability is included in the system specification at the very beginning.

Due to the following features, Chinese Code for Data Communications (CCDC) is selected to store and transmit Chinese information (2).

(1) It contains 16376 Chinese characters.

(2) The Chinese characters are divided into two CCPs (Chinese Character Plane). CCP1 consists of the traditional Chinese telegraph code. CCP2 is newly created to cover other frequently or less frequently used Chinese character.

(3) Two-byte scheme is used to store each Chinese characters.

(4) Code extension is based on IS02022-1982.

4.3 Networking Requirement

Videotex is a new two-way color-graphic media with friendly design and economical concerns in nature. Networking capability should be much emphasized in order to provide easily accessible service.

Since PSTN and PSPDN in this country are two most popular and advanced networks respectively, they establish the data links between the videotex center and videotex terminals.

Through some kind of concentration arrangements in the telephone offices, the customers in Taipei, Taichung, and Kaohsiung can enjoy local calls while all other customers are charged by one local call per every 45 seconds.

The PSPDN in Taiwan, called PACNET, is a very cost-effective network for computer communication. External computers with third-party detabase are encouraged to take advantage of it.

4.4 PC-based Terminal (3)

There are three alternatives so far as the types of videotex terminals are concerned:

(1) TV set with decoder as videotex terminal.
(2) Dedicated videotex terminal, such as minitel in France.
(3) Personal computer (PC) which emulates videotex functions.

Since there are more than 200,000 personal computers used in this country, PC-based approach (3) could be the most feasible start point. Emulation software is sold at the token price.

Later on, the videotex decoder with the Chinese language capability will be developed so that even bigger market penetration can be achieved.

4.5 Database Updating

In order to maintain the up-to-date information in the videotex database, three different schemes are applied:

(1) On-line real-time updating: The database is updated on the transaction basis Typical example is the stock exchange information.

(2) On-line remote-batch updating: The update information are keyed in from the remote site on the batch basis. Typical example is the wholesale market information for daily agricultural products.

(3) Local-batch updating: Local facilities in videotex center are used to update the database on the batch basic. Typical example is the electronic catalog/directory for international trading.

4.6 Phases in Field Trial

The purpose of field trial is to accumulate the experiences and tune the system step-by-step when a new service is introduced. A period of two years, starting from August 1, 1985, is scheduled for the CVS service.

The period is further divided into four phases to let us focus on one out two new functions each time. This kind of "divide-and-conquer" strategy does simplify the world. In our case, the following approach is planned:

Phase 1: Information retrieval
Phase 2: Transaction
Phase 3: Message close user group exchange Gateway to external database
Phase 4: Telesoftware

5. Present Status

Currently the CVS database contains information of the following categories:

(1) Post, Telecommunications, and Transportations
(2) Agricultural products market information
(3) Stock Exchange and Foreign Currency Exchange Information
(4) Business Directories/Catalogs, Economic Activities
(5) News, Tourism, and Recreation
(6) Laws and Regulations
(7) Science and Education
(8) Information in English

About 100,000 frames of information provided by more than 30 information providers are available for information consumers. Among therm, the most frequently used ones are stock exchange information, tourism information, market information for agricultural products, and international trading information. More than three hundred information consumers are now using the service.

The experiences learned during the previous fifteen months can be briefly stated as follows:

(1) Videotex show room will be a big help to promote the service.

(2) Public videotex terminals installed on some strategic locations will effectively educate the public by "to see is to believe" principle.

(3) Index frames should be carefully designed, and consistent formats had better be recommended in the beginning.

(4) Quality of the videotex database should be constantly and closely watched.

(5) Mutual understanding and coordination between the service provider and PC manufacturers should be enhanced.

(6) Better Chinese input method will be necessary for the easy-to-use purpose.

(7) Frame creation system with the capability to automatically translate an image representation of graphic information into geometric elements will speed up the input process tremendously.

(8) Application development system will play a very important role to implement a custom design of specific application in videotex system.

6. Future Plan and Expectations

6.1 Database

Since the CVS provides the first national-wide public database in this country, and the database will become an essential resource to the society, much more efforts should be applied in this area. Both quantity and quality are important in the database contents.

In the near future, telephone directory and yellow pages will be included in the videotex system thru gateway arrangement. This will complement the present computerized 104, 105 telephone directory assistant service which are available almost islandwide.

Chinese keyword search capability will be also studied sooner or later. The Chinese input method will be based on phonetic symbol scheme, the same one used in Chinese teletex.

6.2 Videotex Terminals

Digital TV sets are now available in the local consumer market recently. It is much easier to add on videotex functions in digital TV set comparing to the analog one. Thus high quality, low cost TV set with videotex capability will become the reality in the future. This will contribute the videotex popularity a lot.

Melody will be also available, as in Japan's CAPTAIN system. This is one way to attract users, i.e. a colorful screen with lovely melody.

The long-term target is to dosign an ISDN videotex terminal. Although ISDN is the goal for the year 2000 in this country, many research and development work should start early.

6.3 User Expectations

Overall, the goals to be achieved via the CVS service will be:

(1) Extend the welfare of the nation
(2) Increase the prosperity of the society
(3) Accelerate the coming of the information age.

On the other hand, the following are user expectations which will be gradually satisfied:

(1) Reliable service
(2) Friendly service
(3) Cost-effective service
(4) Flexible service
(5) Enriched service

In conclusion, the bright future for this promising new media will certainly be warmly welcomed.

7. Final Remark

The details about CVS can be found in (4), (5) both in Chinese.

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A Value-Added Model of Electronic Mail Utilization

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1. ABSTRACT

A value-added model is described which shows the cyclic relationships among usage, value and preference in electronic mail utilization. Data collected on the electronic system itself confirms that the system studied has been well received. It is suggested that perceived value in the use-value-preference cycle is a better measure of success than just perceived user satisfaction. Breaking into the cycle effectively is seen as a management and engineering challenge.

2. INTRODUCTION

Office automation (OA) and other computer-mediated communication facilities are often measured and evaluated on the basis of use and user satisfaction (see Carlisle [5] for a summary of papers). Investigators ask questions of various classes of users to find out whether a system (or certain features of systems) are used and whether the user liked the system. However, it can be argued that, in the case of OA for which many of the users are executives and professionals, the notion of value is a better proxy for success.

Office automation is commonly cost-justified by the expected shift of expensive labor from low-level tasks to higher ones [19]. The Booz, Allen and Hamilton study [4] indicated a potential savings beginning at 15% if extra time could be redistributed. This redistribution from "shadow tasks" such as phoning, waiting for information and meetings was the real payoff and not any simplifying, rationalizing or mechanizing secretarial labor [1]. In the 1980's, this redistribution clearly makes even more sense than it did a decade ago when word processing entered the office. However, redistribution alone is not enough. An evaluation must ask two, not one, questions about the impact of user driven technology like electronic mail and computer conferencing:

(1) Does the introduction of the technology facilitate the desired redistribution? and

(2) Does that redistribution make a difference, that is, will the freed up more expensive human resources be effectively deployed?

In other words, even if OA makes an economic difference, does the difference matter?

This study was motivated by a desire to test the idea that differences which OA makes actually matter to an organization. Methodologically, measurements of OA have depended upon the specific hypothesis and models to be tested. The "tool" model requires measures of usage and satisfaction. The "technique" model examines communication patterns [13] and requires work measurement. An alternative model, more appropriate for the present study, examines the perceived value of OA-mediated work in a specific environment.

If OA is viewed as merely a tool the evaluation model assumes that success will follow from the appropriate use of the technology as an efficient instrument. Designers and implementers will seek uses which match the functionality of the features of the technology. In the case of the second model, the focus of design, implementation and evaluation are measures of how the technology alters an office and how its employees work [14]. Finally, the value-added model proposed here probes beyond instrumentality and changed activities and asks "so what?" questions. Kiesler [10] suggests that the answers to these questions will be that value is added in a communication network and the impact will affect the whole fabric of an organization. Specifically, she notes that an organization's problem-sensing capacity is increased as people can make their concerns known much more easily without the bother or time of a typed memo or scheduled meeting.

The value-added model proposes that use, preference and value are interrelated, and differentially affected by design and user factors. Design factors such as ease of use, the presence of menus, on-screen help, and so forth are often treated as motivators for use. However, intuition suggests that a group of highly motivated executives who have to use a well-running, simple, easy to conceptualize system need no such motivators, and in fact these design considerations are merely "hygienic" in Herzberg's [8] sense. If they are gone, satisfaction is low; if they are present in larger quantities, satisfaction is not increased.

Of primary interest to those building or introducing OA systems is the task structure, responsibility level of the users, and the pressure users may be under to adopt the new system. Because this study focuses on executives and professionals in addition to clerical personnel, one can presume that there will be some differences due to position, a factor not as important in a study conducted at only one level (say secretarial). Studies of the value of decision support systems show such a strong position effect [9]. These concepts lead to the model proposed in Figure 1.

To test the value-added model, this study examined the Automated Office Support Services system (AOSS) at the University of Calgary. This system is a modified superset of IBM's Professional Office System (PROFS), which contains the mail, calendaring, and reminder features of PROFS as well as additional features such as telephone directories. AOSS menus are also organized somewhat differently from those in basic PROFS -- as is true of the customizing that most PROFS installations do. The name of IBM's PROFS system was changed to AOSS so as not to be misleading to its users who were administrators not professors. PROFS was first installed here in March, 1983.

The goal of this investigation was to understand the value of this system to users[5]. To this end a questionnaire was devised based on the decision support research of Sanders and Courtney [18]. Following their design, questions were devised not merely to query use of various AOSS features. Additional questions were included to measure users' estimates of the success or value of the system to themselves and to their institution. This methodology is consistent with the preliminary work of Chismar, Kriebel, and Melone [6] who question the importance of subjective measures of satisfaction as surrogates for system effectiveness. Seeing value as a major dependent variable is also supported by the 'tool' approach of Sassone and Schwartz. Their 'Hedonic' model suggests that work restructuring, with a tool like AOSS, leads to employees who not only see themselves as more valuable, but who in fact are more valuable. This is so since a greater percentage of work time is spent on high value activities (e.g. specialized professional activity such as analyzing financial data as opposed to nonproductive tasks like searching for a missing file).

3. METHODOLOGY

At the start of the study, AOSS had been in use for three years. Initial users included senior administrators (and their staffs) who were followed by deans and their secretaries and then other administrators and staffs across campus. This installation was done in a definite top-down fashion with the President's clear support. Uhlig, Farber, and Bair [21] imply that a top down implementation would prove most effective while the innovation literature [22] though supporting this, points out the importance of lower level acceptance as well.

The user population consisted of 304 executive, professional, and secretarial personnel who had id's on the University's electronic AOSS network. Only four of these share a terminal; the rest have their own. Following an informal pretest of five users (who indicated no problem and expressed enjoyment completing the survey), each of the 304 users of the system were electronically sent the instructions in Appendix A followed by the 30 questions in Appendix B (if they chose to complete the survey). The instructions appeared on several screens which could be scrolled. Participation was voluntary and users could withdraw at any time. The material which is in **bold** type at the bottom of Appendix A remained on the screen at all times so that respondents knew which keys should be pressed.

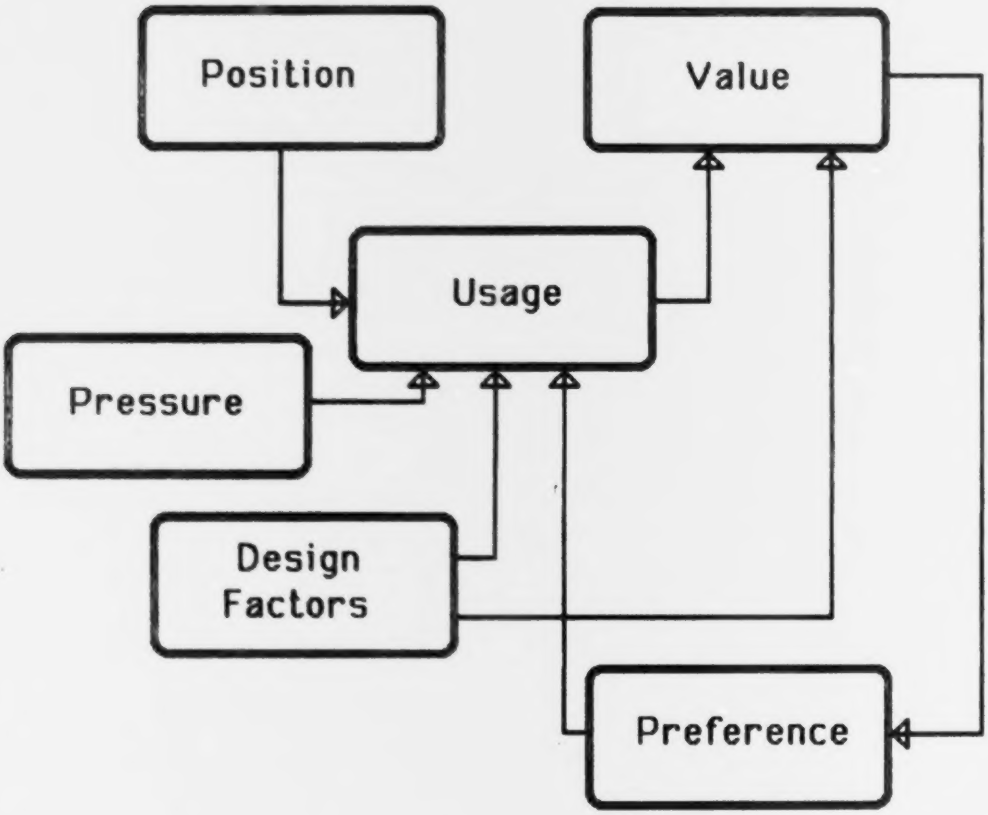
IBM's EXEC2 language was used to send and collect the questionnaire responses. Once collected, the responses were relayed from the IBM host running the AOSS system to the campus Honeywell mainframe for data analysis.

A person could respond only once. The fact that people generally seemed to enjoy responding was indicated by two users asking to participate a second time after inadvertently sending their responses before answering all questions. Though all respondents were assured of anonymity (by having their id's automatically stripped before their replies were sent), the abbreviated responses of these two individuals were easy to determine and delete -- so that a second response set could be allowed and counted correctly.

After the survey was "on the air" for 12 days, 122 responses had been received with the reply rate having tapered off to no more than one response per day. At this point the survey instructions in Appendix A were resent to all users with a three line reminder thanking them if they had responded and encouraging them to participate if they had not. Given the anonymous nature of the reply procedure, all 304 users received the same reminder message as it was not possible to know who had responded to the initial survey message.

Figure 1.

A Value-Added Model for Office Automation.


Position
Value
Usage
Pressure
Design Factors
Preference

The 170 responses finally received were imbedded in the questionnaire message itself, and so it was necessary to reformat this data into a typical "flat" file for statistical analysis. The SNOBOL4 language was used for this purpose. This reformatting procedure also made it possible to remove ten people who had responded in the wrong place or who had used "yes" or "no" for their responses instead of a number[4]. Of the remaining 160 useable responses, three and part of a fourth were incomplete and and these omissions were treated as missing values.

4. RESULTS

The mean responses to each question followed by the standard deviations are included after each question in Appendix B[5]. In four questions the distribution were clearly bimodal as respondents were divided into those either agreeing or those disagreeing. In these cases "[bimodal]" is appended to the statistics which must be interpreted with caution because of this distribution.

The overall picture which these means (and the distribution on which they are based) convey is one of high agreement that AOSS is an easy-to-work-with tool as well as a valuable and preferred one that receives frequent use. For example 75% either agreed or strongly agreed that it was easy to use. This rises to 90% when the category of slightly agree is also included. Nearly three quarters of all respondents (73%) also expressed some level of agreement that they were frequent users of notes in AOSS mail. Calendaring, reminders, and the telephone directory each received respectively less use than AOSS notes. Less than a quarter of the respondents used AOSS for others or on their behalf -- though this was greater than the explicit sharing of four terminals which were known about. With respect to the voluntary nature of use, users were divided between those who indicated their use was voluntary (with 62% expressing some form of agreement) vs. 29% indicating disagreement that their use was voluntary. Measures of value such as personal benefit, doing a better job, being more timely in communications all had more respondents agreeing than disagreeing.

With respect to length of use or experience with AOSS, the mean of 18.4 months does not indicate the skewed distribution of longer use with 37 people having used the system for 30 months or more. People from all position levels were fairly evenly represented with 34% indicating a secretarial job, 24% a professional position, and 30% an executive one.

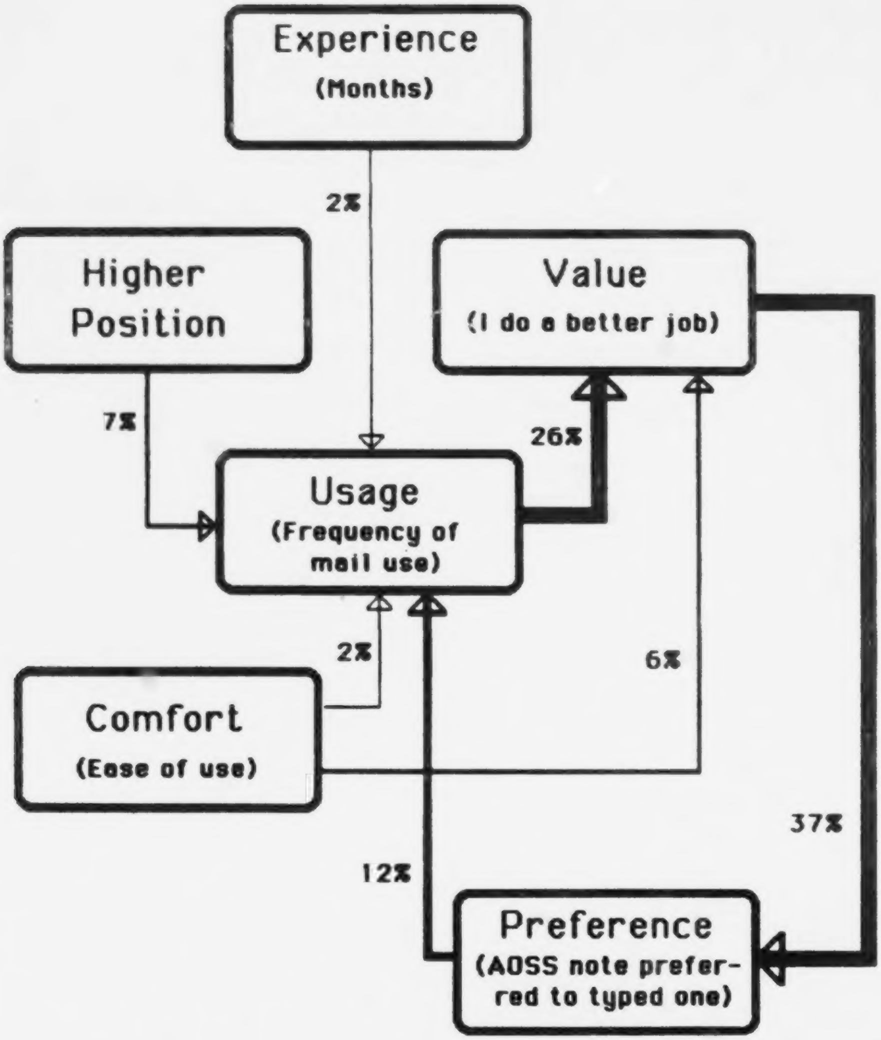
In order to determine potential interrelationships in the use, preference, and value behaviors of these AOSS users, the data was subjected to several iterations of factor analysis with varimax rotation. Not surprisingly, the first thing that this determined was that there were a number of questions that simply did not fit with the rest. Their lack of correlation with other variables suggested that "use of other computer applications," "liking for hi-tech", and "use of the link to the Honeywell Multics academic machine" were not germane to the fundamental use and value of electronic mail and other features of AOSS. Thus these variables were dropped from the factor analysis. It was further assumed that the use of the four main features of AOSS (mail, calendars, reminders, and telephone directories) could be combined into a single index. When this was done the resulting analysis yielded six factors with eigenvalues greater than 1.0. The variables with loadings of .50 or greater on each of these factors are listed in Table 1 -- as well as suggested names for the factors.

With the goal of determining reasonable causal relationships between these factors, the three apparent dependent variables in these factors of "frequency of mail use", "perception of doing a better job", and "preference for AOSS over a typed note" were each regressed against the main variable in the other five factors (with the exception of Factor 5: 'others' -- which is likely an artifact of just the two questions that load on it). Table 2 gives the percent of variance each of the potentially independent variables explain in these three dependent variables. This table also indicates which variables significantly contribute to this prediction (as measured by an F test). It should be noted that "frequency of mail use" was treated here as a single factor rather than including it in an index as before. This was done because the original responses to all the usage questions indicated that mail was used far more than any of the other features of AOSS[6]. The variable of voluntary use (as a measure of external pressure) was also included in these regressions a priori as it seemed that this should have an effect on value and use -- if for no other reason than the potential of cognitive dissonance [7] of users who must willingly take up a task extolling its virtues else they look foolish for using it if they do not. However, as is seen in Table 2 this variable did not predict value, use or preference variables.

The model in Figure 2 -- adapted from Figure 1 -- is constructed using those variables which significantly predict other variables. Percentages in this figure as well as the thickness of the connecting lines indicate the degree of predictive relationships. This model is helpful not only in showing what affects value and preference but also for showing what does not. Neither longer experience (months of use), higher position nor increased comfort with the system strongly affect usage. However, those who use the system do value it and feel they are doing a better job. This perceived value also predicts their preference for it.

Figure 2. A Value-Added Model of AOSS.

(With Significant Percentages of Variance Explained, > 1%)


Experience
(Months)
2%
Higher Position
Value
(I do a better job)
7%
26%
Usage
(Frequency of mail use)
2%
6%
Comfort
(Ease of use)
37%
12%
Preference
(AOSS note preferred to typed one)

The interrelationship of these three factors receives support from Baroudi, Olson, and Ives [2] who surveyed 200 large manufacturing firms and confirmed that user involvement in system development (an early perception of value) enhances both user satisfaction and system usage. The path coefficient they found of .24 from involvement to satisfaction (which could be interpreted as preference) though explaining a much smaller percentage of variance than found here (i.e. square root of 37% = .61 vs. their .24) is not incomparable given the greater distance that early involvement is from actual perceived value of an operational system. If one continues to interpret user satisfaction as 'preference' then their path coefficient of .24 predicting usage from this factor is also not dissimilar to the 12% of variance preference explains in usage in the present study (i.e. the square root of 12% = .34 which compares to .24 found by Baroudi *et al*.)

5. DISCUSSION

These results point to the strong cyclical relationship holding among use, value and preference for the AOSS users who responded to the survey. Furthermore, the data seem to show that few design or user factors influence use, value or preference. In particular, position has a significant but slight effect on use; ease has only a small influence on perceived value; and experience, like use, exercises a minimal influence (just 2%) on usage. None of the design or user factors had any influence on judgments of preference.

Two observations are important. First, the cyclical nature of influence among use, value, and preference is not unanticipated. If a technology is objectively good in specific situations, then users will see the value and come to prefer it only if they use it or prefer it *a priori*. Breaking into the cycle becomes a marketing or management effort. "Try it, it's worth it, you'll like it," is the cycle's major premise.

Second, there are few ways to influence preference or value directly except through use or advertising. Position has an indirect influence on preference through use and value. The simple correlation between position and preference was an insignificant -0.06. Making a system easier to use will directly influence perceived value a bit (but as has already been suggested, ease is a hygiene factor -- AOSS is already easy to use according to 90% of the respondents), but ease has only a small correlation with use ($r = 0.28$, $p < 0.001$). In other words, neither position, perceived ease of use, nor experience has much influence on the perceived value of the system in terms of being seen as contributing to doing a better job.

The challenge then is either to find factors that influence value directly or to adopt innovation strategies that capitalize on the strong use-value-preference loop. Possibly an innovation strategy such as that used in the AOSS introduction was effective in producing the high values and preference (only 15% and 10% indicated little value and lack of preference respectively), only because AOSS *is* easy to use and effective. Were this not the case, substantially lower values for use, value, and preference would have been expected.

In future studies there is certainly a need to investigate further the hygiene affect of ease of use. It is also likely that an appreciation for "high technology" is bound to vary in the general population from its expected high value in a university setting. The presence of only three factors in the present looping model may have to be changed when a wider spectrum of user variability is included -- particularly at the high end of design factors. A study by Nicholson [16] on the usage of voice mail showed a familiar 80-20 distribution of usage (80% of the traffic was generated by 20% of users) in their integrated voice/text mail systems and 70-30 for the voice system alone. Interviews with ten users stressed that design factors influenced preference for both systems (*not* that one system was always preferred to the other) -- suggesting that high-technology systems might be sensitive to design factors, but in very personal ways. Additionally, Nicholson found no correlations between job category and voice use, which is confirmed by the present study.

This brings up one final question alluded to earlier. Given the tight use-value-preference loop, which variables are the best indicators of a computer-mediated communication facility's success -- at least in the present context? Value seems to be the choice here since it is directly influenced by both use (often forced on users) and design factors. Preference is influenced only by value. Value questions (e.g. "Because of my use of AOSS, I see myself as a more valuable employee") seem to get closer to the reason for introducing OA in the first place. As a way of increasing value even more, systems will simply have to be made more attractive by including truly worthwhile features such as direct speech input of document text (at a practical speed and cost).

This does have the problem, however, that users are seldom able to judge a system's value until they have used it for a considerable period of time. As Tapscott [20] has found, satisfaction with a system -- and one can assume its perceived value -- increase over time, thus one must extrapolate from similar present installations to contemplated future ones to predict a system's success. Unfortunately, OA evaluation has not progressed to the "engineering" stage such that a multi-faceted model has emerged (ala Boehm's [3] cost model for software projects); the present value-added model should serve as a start, nonetheless, for what might become office automation engineering. More studies in other contexts need to be done and predictive coefficients for value, use, and preference need to be refined so that different sets are available for these different settings. In addition, this model needs to be investigated longitudinally with sampling done several times during a system's life cycle -- though such an approach runs the risk of the same questions being interpreted differently at different dates as a system's technology evolves.

However, one must be cautious in adopting an engineering framework completely lest too much of a taxonomic approach be taken. Nippins and Safayeni [17] point out that for a variety of reasons a taxonomic approach to design of OA to meet needs apparent in task structures (i.e. taxonomies) is deficient. An implication is that value cannot be approached in an analytic way ("we need so much of this for this task and so much of that for that task"). They claim -- albeit without proof -- "that it is probably easier for the organization to learn or buy technology expertise than it is for a consultant/researcher to learn about the organization's procedures using the methodologies currently available." (pp 338-339). In other words a priori knowledge that might assist a priori determination of value through task-related benefit is untrustworthy. The value-added approach as described here looks at subjective evaluation of a system's total contribution to a job and clearly seems to be more promising.

6. NOTES

(1) Authors listed alphabetically.

(2) We would like to acknowledge the generous assistance of Shepard Braun, Special Assistant to the President for Office Automation, Ed Nowakowsky, Director of Administrative Systems, and most particularly, the programming and technical advice of Al Judson, Manager, Office Automation Group. This paper would not have been possible without their help.

(3) It should be noted that PROFS has already been demonstrated to be a tool capable of freeing up users' time for other activities of whatever nature [15].

(4) In retrospect, the survey procedure should have locked out all but numeric responses in the appropriate place, nonetheless, those who responded with "yes", "no" or phrases such as "not really" could have had their answers changed to numbers on the seven-point Likert response scale. This was not done in this analysis as it was felt that these repondents did not follow directions and hence may not represent typical users.

(5) Though parametric statistics could have been used, it was felt that it was not unreasonable to assume that the seven-point Likert agree-disagree scales are in fact interval scales and hence amenable to parametric analysis [11]. The use of more powerful parametric tests is also appropriate in this rather new area of study where one is interested primarily in detecting correlations and trends while accepting the risk of including some spurious findings. Once refutable theories emerge, a more rigorous approach will be called for.

(6) This is not surprising for a variable such as calendaring given the work of Kincaid, Dupont, and Kaye [12] who have shown that most electronic calendars are too rigid and a poor substitute for their paper equivalent. Their methodology included interviews with users of 140 workstations in two groups, mostly professional and middle and senior management, as in the present study. Reported usage was quite low and reasons given included descriptions such as ease of use, availabililty, lack of portability, and limited data entry. Some indicated lack of value but primarily they expressed little preference for electronic calendaring over "date books". The authors did not attempt an analysis of the relationship between usage, value and preference of this fairly limited system.

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8. APPENDICES

8.1 Survey Instructions

The IMPACT Research Group, located in the Faculty of Management, investigates the interrelationships of information, management and technology and their effect on people. As part of its research efforts, the IMPACT Research Group sought and received approval, from the President's Executive Advisory Committee and the Office Automation Project to conduct a survey of AOSS users. This survey on electronic mail and other aspects of AOSS is a further effort in IMPACT's continuing series of studies in the area of management and technology and is NOT an administrative review of AOSS. The survey asks questions about frequency of use, preference for AOSS features, and your perception of the influence AOSS has had on your work. Responses will be kept completely confidential; only summary statistics will be used in reports which may stem from this study. All links with your name will be destroyed BEFORE your response is received by the IMPACT Research Group.

Participation in this questionnaire is purely voluntary; if you consent to take part, return to the main AOSS screen and key in the command SURVEY. You may exit from the survey at any time by pressing PF12. The questionnaire must be completed during one session. Completed questionnaires are mailed by pressing PF3.

___INSTRUCTIONS FOR ANSWERING QUESTIONNAIRE__

ENTER YOUR ANSWERS ON THE BLANK LINE FOLLOWING EACH QUESTION

1 = STRONGLY AGREE 2 = AGREE 3 = SLIGHTLY AGREE 4 = NEITHER AGREE OR DISAGREE 5 = SLIGHTLY DISAGREE 6 = DISAGREE 7 = STRONGLY DISAGREE

PF3 MAIL SURVEY PF8 SCROLL FORWARD
PF12 TO EXIT FROM SURVEY

8.2: Survey Questions (with mean responses and standard deviations indicated below each question)

A) AOSS is easy to use.
2.2, 1.3 <-- PLEASE ENTER ANSWER ON BLANK LINE BETWEEN QUESTIONS.

B) I feel confident in using AOSS
2.2, 1.2

C) I'd rather receive an AOSS note than a typed letter or memo.
3.2, 1.6

D) I'd rather receive an AOSS note than a handwritten message or letter.
2.5, 1.6

E) I'd rather receive an AOSS note than a telephone call.
3.4, 1.7

F) I am a frequent user of AOSS mail.
2.8, 1.9
PRESS PF8 to continue . . . . . .

G) I am a frequent user of AOSS calendaring.
3.9, 2.4 [bimodal]

H) I am a frequent user of reminders in AOSS.
4.9, 2.1

I) I am a frequent user of the telephone directory in AOSS.
4.1, 2.2 [bimodal]

J) I also work with other computer applications (besides AOSS).
3.0, 2.3 [bimodal]

K) I frequently handle AOSS notes for a person in my unit who does not have AOSS access.
5.4, 2.0

L) I frequently send mail on behalf of other AOSS users (ie. my boss)
5.5, 2.0
PRESS PF8 to continue . . . . . .

M) I share a terminal with another user(s).
5.9, 2.0

N) My use of AOSS is voluntary (as opposed to required by my job or boss).
3.9, 2.3 [bimodal]

O) I am a good typist.
3.3, 2.1

P) I like high technology.
2.3, 1.2

Q) Because of my use of AOSS, I see myself as a more valuable employee.
3.1, 1.7

R) Because of my use of AOSS, others see me as more valuable to the University.
3.6, 1.8
PRESS PF8 to continue . . . . . .

S) Personally I have benefited from AOSS.
2.6, 1.6

T) I have come to rely on AOSS in performing my job.
3.0, 1.9

U) Using AOSS has made me a more effective communicator.
3.2, 1.7

V) As a result of my use of AOSS notes, I am more timely in my communications.
3.0, 1.8

W) As a result of AOSS notes, more relevant information has become available to me.
3.2, 1.7
PRESS PF8 to continue . . . . . .

X) Having the AOSS-to-Multics link has been helpful in my use of AOSS notes. [NOTE: Multics is the Honeywell mainframe system that is used for academic as opposed to administrative processing.]
4.1, 2.0

Y) AOSS has led me to better use of other communication aids and systems.
4.1, 1.7

Z) All in all, I do a better job at the University because of my use of AOSS.
3.3, 1.7

AA) The University itself is better off as a result of AOSS.
2.5, 1.5
PRESS PF8 to continue . . . . . .

For the following questions please answer with the most appropriate number.

BB) Approximately how many months have you been an AOSS user?
18.4, 10.8

CC) How would you describe your position at the University?
1 = Secretarial (including administrative and executive assistants).
2 = Professional (including analysts, technicians and programmers).
3 = Executive (including VP's, Deans, Directors, and dept. heads).
4 = Other
2.0, 0.9 [13 responses of "other" were not included in the analysis]

DD) Please tell us your sex:
1 = Female
2 = Male
1.5, .5
PRESS PF8 to continue . . . . . .

MANY THANKS FOR YOUR HELP !

WE HOPE TO HAVE A SUMMARY OF THE RESULTS IN THE GAZETTE QUITE SOON.

IMPACT RESEARCH GROUP
Faculty of Management

TO MAIL QUESTIONNAIRE, PLEASE PRESS PF3

TABLE 1.

AOSS Factors and Variable Loadings (greater than or equal to 0.50).

	Loading
Factor 1: "Value" (59% of survey response variance)	
I do a better job (Question: Z)	.89
More effective communicator (V)	.83
More relevant information available (W)	.78
Timely in communications (V)	.78
Rely on AOSS (T)	.77
University better (AA)	.76
Personally benefited (S)	.75
See self as more valuable (Q)	.70
Others see me as more valuable (R)	.60
Use other communication aids (Y)	.58
Use index (use mail, calendaring, reminders, and telephone directory (F-I)	.54
Factor 2: "Position" (19% of survey response variance)	
Position (CC)	.84
Sex (DD)	.80
Good typist (O)	.56
Factor 3: "Preference" (7% of survey response variance)	
AOSS note rather than typed note (C)	.71
AOSS note rather than handwritten note (D)	.67
AOSS note rather than phone call (E)	.56
Factor 4: "Comfort" (6% of survey response variance)	
Easy to use (A)	.73
Confident in using (B)	.67
Factor 5: "Others" (5% of survey response variance)	
Handle AOSS for others (K)	.73
Send mail for others (L)	.67
Factor 6: "Experience" (4% of survey response variance)	
Months used (BB)	.57

Table 2. Predictors of Dependent Variables.

Dependent Variable:
Doing a Better Job ("Value")

Predictor Variables:	Beta	F	Change in R^2 (%)
Frequent Use of Mail	0.43	28.92**	26
Months	0.08	1.03	1
Voluntary Use	-0.05	0.40	0
Position	-0.16	3.65**	1
Ease of Use	0.26	11.71**	6

Dependent Variable:
Frequent Use of Mail ("Usage")

Predictor Variables:	Beta	F	Change in R^2 (%)
Prefer AOSS over typed note	0.28	11.78**	12
Months	-0.17	4.78**	2
Voluntary Use	-0.02	0.05	1
Position	-0.31	13.28**	7
Ease of Use	0.16	3.90**	2

Dependent Variable:
Prefer AOSS over Typed Note ("Preference")

Predictor Variables:	Beta	F	Change in R^2 (%)
Doing a Better Job	0.60	53.89**	37
Frequent Use of Mail	0.07	0.78	0
Voluntary Use	0.10	1.54	0
Months	-0.02	0.07	0
Position	0.15	3.53**	2

** ($p < 0.01$, df = 5, 126)

The Study for the Advanced Use of CAPTAIN
-- Videotex Information Service in Corporation --

Yurihiko Tamechika, Tomoko Kano
FUJITSU LIMITED, Tokyo, Japan

1. Abstract

The commercial CAPTAIN service (Videotex service name in Japan) has been served in November, 1984 in Japan.
FUJITSU started Videotex trial corporate information service in December, 1985, and worked Private center in Kawasaki factory and formally started this service in March.
This paper reports the objective and outline of this service.

2. Introduction

In Japan, information services by means of several new media started in 1984. They include communication with isolated islands by means of communication satellite Sakura 2, high-speed digital communication service, and teletext. In November 1984, videotex service started, a new public network service provided through telephone circuits and television by NTT.
Figure 1 (appendex) shows the new media systematically arranged.

There are two types of tools for new media: a new communication system acting as infrastructure of the information intensive society (satellite communication, optical cable communication system); and new communication systems (CATV, videotex and teletext) in which collection and generation, processing, transmission and utilization of information were integrated. In addition, services which use those tools are classified by their application (home shopping, corporate banking etc.).
Such new media have appeared one after another, but many of them are not actively utilized. This is because those systems have outrun their supporting services.

Fujitsu has been developing information center software, user terminals, and information input devices for videotex since before commercial service started. In particular center software is at the world highest level. Although we were consulted on how to construct a system, we lacked knowledge about how to use it.
For the above reason, we planned to use a videotex system as a user.

3. What is Videotex?

Services to obtain required information at a desired time by connecting home television sets or personal computers in the office through telephone lines is called videotex.

CCITT, with development and practical use of videotex growing around the world, has proceeded with the international standardization of a display system for videotex and its protocol in Working Party 1 of Study Group VIII (SG VIII). CCITT recomended four standards by function in 1980 and three international standards in 1984. Comparison of three international standard systems and relative display functions are shown in Table 1 and Table 2 (appendex).
Expression level protocol in these videotex corresponds to the Open System Interconnection (OSI) of the International Organization for Standardization (ISO) as the sixth layer of the communication protocol model (in a seven-layer hierachical structure), and defines coding methods, interpretation of code and data format of provided information such as characters, graphics and music.
The CAPTAIN system have the following features compared with other systems.

(1) Standardized protocol
In CAPTAIN, the first to fifth layer of protocol are standarized, such as transmission procedure and data transmission speed. This allows flexible interconnection between user terminals and the information center, unlike other data communication systems.
(2) Employment of Hybrid system using code system and pattern system together. The hybrid system can display the screen at high speed using a code system. It also has many graphics capabilities using a pattern system.
(3) High-speed display
Code system allows high-speed character screen and masaic graphic screen display of about one second over usual telephone lines (for a pattern screen, is about 8 to 10 seconds).
(4) Various graphic displays.
CAPTAIN can display graphics in the following three modes.
- Mosaic graphic
- Geometric graphic
- Photographic graphic

(5) Many characters can be displayed.
High density display screen can display 480 characters of Kanji and 1920 characters of other types per screen. This volume of information is enough for many business uses.
(6) Mutiple screens can be displayed in one screen
Four standard density screens can be displayed at the same time on the screen where high density display is allowed.
(7) Music can be output.

Music and sound effects added on the display screen make the CAPTAIN more familiar and warm to users and are useful functions to enhance the screen display's effect of a game-like advertisement for the information provider.

(8) Multiframe display function
In CAPTAIN system, geometric graphic is overlaid on photographic graphic, and then characters are overlaid on the geometric graphic. Part of the screen can be changed, or all of it can be scrolled.

4. Objective of In-house Videotex

As mentioned at the beginning, a plan was proposed to actually utilize videotex in-house to support consulting for users as a manufacturer. We decided to use it as a new OA tool because it makes information supply and usage easier than the old information service system. The following is the operational objective of in-house videotex.

(1) Research on use of videotex in company and acquisition of consulting capability for users.
(2) Increase of knowhow for product development
(3) Uniform and rapid distribution of in-house information as a link in full company OA.

"A link of full company OA" means that in videotex anyone can easily input information and anyone can obtain the information at the same time. We thought we could eliminate problems such as distribution and circulation of various reports in-house, and standardize and speed up the distribution of information. Actually, reports dispatched from offices located all over the country amount to a great volume. Servicing these reports using videotex can prevent waste of resources and losing sight of truly necessary information.

5. Network Construction

Seventy-five user's terminals were installed at the 27 offices in the country to let many workers gain experience, and we started test operation in October 1985.
Originally we utilized at NTT Corporation-type information center, but in March 1986 we started operation of an M-380 in Kawasaki factory as our own center. At the same time we replaced the use of low NTT videotext communication network with the use of our in-house leased-line network. This reduced communication fees to almost for nothing. We paid 30 yen per 3 minutes before this change.
Network construction is shown in Figure 2 (appendex).

6. Outline of service

When users call the information center and the connection is completed, user ID and password are checked. Because this is an in-house information service system, some information causes trouble if retrieved by outside users, so this qualification check is made in two steps. Input of user ID is useful to obtain use statistics. Information retrieval is not allowed without the above qualification check.

Current service conditions is as follows.
Information providers are from 17 departments, there are 21 supplied programs, and pictures total 2000.
The content and suppliers of information now serviced are shown in Table 3 and 4. (appendex)
Here are some popular program.

(1) Industry news
One to three items of news related to our company or to the industry are input from newspapers everyday. In addition to these detailed news items, indexes of all news in a day are displayed.
(2) New Product guide
New products of our company are introduced with illustrations. Often a local branch can not get the catalog immediately when a new product is announced, so this screen is useful to get hard copy for a simple product.
(3) Office guide
Maps of offices located all over the country are shown in relation to the nearest railroad station. A guide to hotels and inns serviced with this program is very populer among users.
(4) Guide to SE report issue
Our company issues a report for SE once a week. this guide introduces all the titles of these reports.
(5) Total guide to FUJITSU products
An outline and the features of all products sold by FUJITSU are introduced.

The above five programs are well utilized every month. There are 21 programs in all, some programs such as those introduced here are well used, but on the contrary, there are some programs which are not used at all. The differences between the two are: Is maintenance of the information frequent? Is the information useful for business? The life of an information service is in its product's freshness. If information obtained from videotex is no different from that obtained from old media, no one will bother to use videotex.

That information is useful for business does not mean that the information is used every day. Information which is used every day and not changed often is useful when printed and carried by individual persons. Information suitable for videotex is usefull for business, only occasionally used, but important. The above two points are important conditions for any in-house information service. Videotex is no exception.

7. Current problems and measures to remedy them

Six months have passed since information service by videotex was started. In that time, some problems have occurred.

(1) Interesting information is not enough
There are various kind of sections such as SALES, SE, CE and management departments in the company. The content of information service programmed by people in one section tends to be slanted. Actually, the only information used company-wide is the office guide.
The information providers did not know how often their supplied information was used because there was no feedback to them. This reduced their desire to supply information, so maintenance and improvement of information was not done as scheduled.

(2) Terminals are few
Forty-three terminals out of 75 are located around the head office. Only 27 offices out of 80 have a terminal.

The following measures were discussed for the above three problems.

(1) Recheck Information
We decided to hold coordination meetings for in-house videotex at a regular palce and time. This meeting discussed operation of the information center, technical assistance, network construction, screen input, and sales company information service.
Seven working groups were established under this meeting. These WG are classified by the content of information services, and mainly discuss the services.

(2) Relocation of terminals
Discussion is to be made of changing location of less frequently used terminals, examining utilization conditions for six months and changing the current system of concentration around the head office to a distribution system around the country.

8. Future extension plan

At present, the system is used only for simple information retrieval. We are planning to supply services such as order entry and an electronic bulletin board, making the best use of the merits of videotex, which can freely program applications using the computer.
An electronic bulletin board is a system such that when name and message of the recievers are input from a user terminal keypad, the receivers can read the message.

Until now, service has been limited to within the company, but it is scheduled to extend to the wholesale and retail distributors of our company. About 2000 distributors need the following items of information.

- Information to improve office work in company.
- Information to increase sales.
- Information for skill upgrading.
- Information to make the best use of store space.
- Information to solicit customers.

For these needs, comparison and analysis were done on services by means of videotex versus personal computer communication. As a result, we concluded that information service by videotex should be given priority because it is cheap, easy-to-operate, and of public service.

9. Consideration

Videotex is better than other media for the following reasons from the user's viewpoint.

(1) It can be more easily operated than conventional personal computer communication.
(2) Required information can be obtained at the desired time.
(3) Information is expressed in an easy to understand way by means of characters and graphics.

The following are the merits for the information provider.

(1) No application program need be developed to supply information. Input can be operated in the same way as a word processor.
(2) Information can be easily input. Energy and personnel expenses are saved because a full-time operator is not needed.

(3) Existing telephone network is available. Constructing a new network is not required.
(4) Existing data base can be used without any modification.

Videotex has the above merits, but it is not the best media for the information service of the whole company. To well understand the merits of other media and to use the best for each purpose is also important. Table 5 (appendex) shows an example of media sharing.

This table shows that videotex is the best medium for reservations, simple order entries or simple memos, making the best use of the merits "anyone can use simply; easy to understand".
In addition to in-house data bases, external data bases can also be retrieved.

10. Conclusion

About six months have passed since service started. Information serviced by videotex is still being serviced also by paper. In-house videotex is not as well utilized as expected. It is a great waste to distribute the same information by several media. Real OA is achieved when sharing information media is fully achieved and one information is serviced by one media. It may be early to draw conclusions because only six months have passed since service started. Active discussion in WG on information needs of various field and practiced experience are required. For user terminals, development of a new adapter is required, which will not require an exclusive terminal but use existing terminals as videotex terminals. Some improvements were proposed to center-side software to utilize the system. We found some limitations to using PBX and DMIX for construction of an in-house network as well as products related to videotex.

Videotex is not yet a useful system for users.
We are now accumulating knowhow to improve videotex into a useful system.
We intend to build an easy-to-use system based on this knowhow.

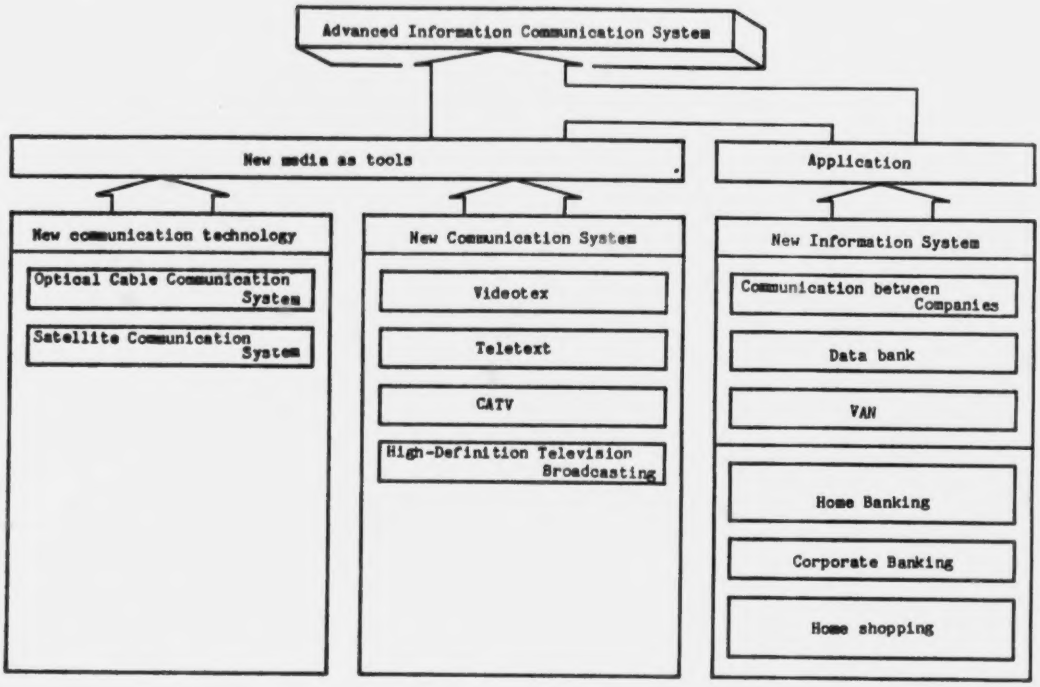

Advanced Information Communication System
New media as tools
Application
New communication technology
Optical Cable Communication System
Satellite Communication System
New Communication System
Videotex
Teletext
CATV
High-Definition Television Broadcasting
New Information System
Communication between Companies
Data bank
VAN
Home Banking
Corporate Banking
Home shopping

Figure 1

Outline of sysytem

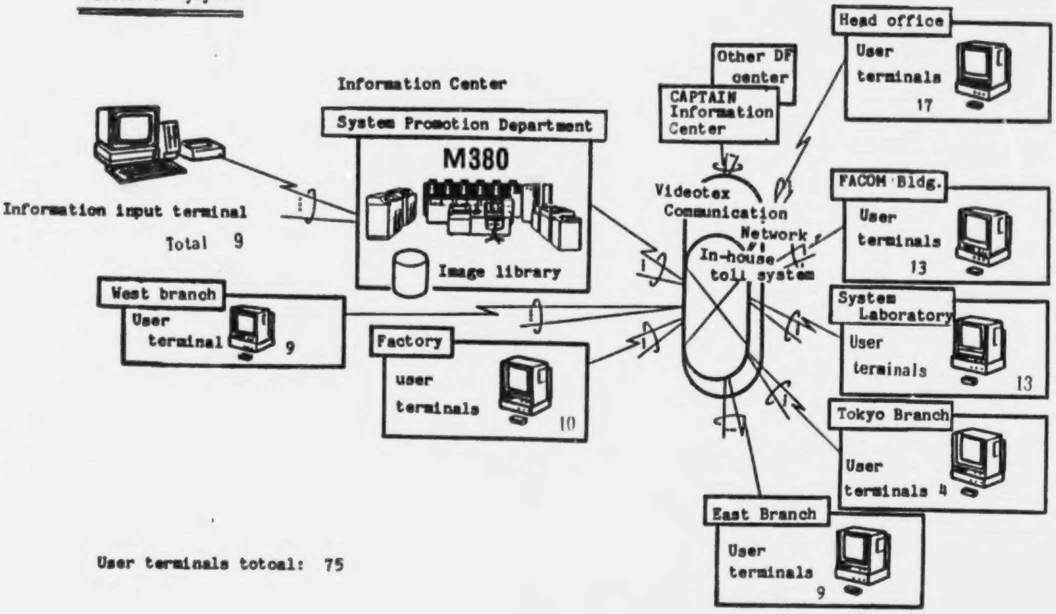

Information Center
System Promotion Department
M380
Image library
Information input terminal
Total 9
West branch
User terminal 9
Factory
user terminals 10
Other DF center
CAPTAIN Information Center
Videotex Communication Network
In-house toll system
Head office
User terminals 17
FACOM Bldg.
User terminals 13
System Laboratory
User terminals 13
Tokyo Branch
User terminals 4
East Branch
User terminals 9
User terminals totoal: 75

Figure 2

Videotex protocol system

Items	System	Graphic Display features
①	Alpha mosaic system	· Graphic display by combination of mosaic pieces. · Based on European CEPT system(* 1).
②	Alpha geometoric system	· Display of graphic outline by combination of geometric command in straight line and arc. · Based on North American NAPLPS system(* 2).
③	Alpha photographic system	· Graphic display by dot pattern(pixel). · Based on Japanese CAPTAIN system(* 3).
④	DRCS system (* 4)	· External character display system of characters and sign. · Each system of above 1 to 3 is incorporated in each method.

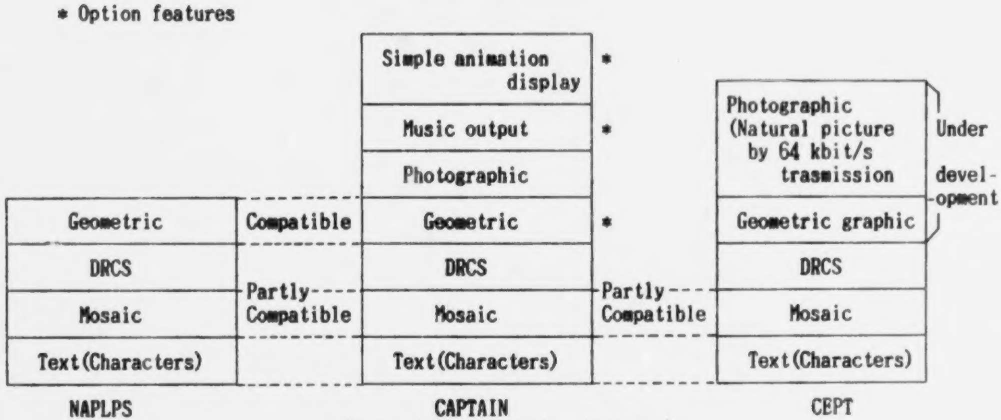
***1 CEPT: Conference Europeenne des Postes et Telecommunications.**

***2 NAPLPS: North American Presentation Level Protocol Syntax**

***3 CAPTAIN: Character and Pattern Telephone Access Information Network**

***4 DRCS: Dynamically Redefinable Character Set**

Table 1


* Option features
Simple animation display *
Music output *
Photographic
Geometric *
DRCS
Mosaic
Text(Characters)
Geometric
DRCS
Mosaic
Text(Characters)
Compatible
Partly Compatible
Partly Compatible
Photographic (Natural picture by 64 kbit/s trasmission
Geometric graphic
DRCS
Mosaic
Text(Characters)
Under devel-opment
NAPLPS
CAPTAIN
CEPT

(Comparison of display features)
Table 2

Information Provider /Content of information ex).

	Topics	Information supplier	Contents
1	Industry news	Publicity room	Our company news, other company information
2	Guide of SE report issues	System technical department	History of SE report issues
3	Outline of company	Commerce department	Outline of company
4	New product information	Publicity department	FM-77AV, M780, etc.
5	General product catalog	Sales assistance department	General product catalog
6	Office guide	General Affairs of each branch	Map of office, guide to hotels and inns
7	Guide from Education office	Education office	Reservation status of training courses

Table 3

〔 User statistics on in-house videotex 〕

1. Period in which lists were totaled. June/16 to June/30 (Working days 11)
2. Total numbers of pictures 3300
3. Total numbers of accesses 7871
4. Number of accesses per picture 2.4
5. Classified by content (In order of accessed times)

Order	Content of information	Number of pictures	Number of accesses pictures
1	Industry news	319	3117
2	Fujitsu videotex services	293	2260
3	Guide to office	212	1971
4	New product information	37	1108
5	Guide from Education office	226	953

Table 4

Media Application		Personal computer local Processing TTY communication	EDP (F6650EM)	Videotex	FAX	Telephone
Reservation (Conference room, etc.)		○	△	◎	×	○
Order entry	High-level O.E.	×	◎	×	×	×
	Simple O.E.	○	×	◎	×	△
Information management	Data Base	○	◎	△	×	×
	Filing	○	○	◎	○	×
Local calcu-lation		◎	×	×	×	×
Point to Point communication		○	×	△	◎	◎
Retrieval of external DB		◎	×	◎	○	×

Table 5

Electronic Mail and
a Private Satellite Network

Christine Wirth
Catholic Telecommunications Network of America
Staten Island, New York

From the earliest days of its existence to the present, the Catholic Church in the United States has sought to use every means at its disposal to communicate its message of evangelization to all who could be reached. Today, of the many communications media available, Electronic Mail is probably the newest to assume a role in the age-old mission of the Church.

I. An Explanation of the American Catholic Church and CTNA

From the tenuous beginnings of lonely, scattered missions in the desolate vastness of the New World to the vastness of today's modern corporate-like operation, the Catholic Church in the United States has sought to evangelize, socialize and civilize through social influence of the masses.

One of the basic tenets of the Catholic faith is the importance of teaching, the mandate from God to provide Christian witness through one's words and deeds in order to convert others to Catholic belief and life. Through the ages Catholics have used every means at their disposal to fulfill this duty to God.

In the 16th and 17th centuries, missionaries used word of mouth to convey their message in the North American territories. With relentless travel, braving harsh terrain and even harsher enemies, these early American Catholics converted native American Indians to Christianity. They had to contend with scarce supplies, short-handedness, virtual isolation and violence from the Indians who protested their presence as well as warring imperialists France and Spain.

By the time of the first English settlement at Jamestown, Virginia in 1607, separation of the Church in England from Rome was an accomplished fact. The Puritans and Protestants who populated the British colonies were sternly opposed to Roman Catholicism. It wasn't until after the American Revolution, with the adoption of the Constitution and Bill of Rights, that religious tolerance for all Christians became the general practice.

The structure of the Roman Catholic Church had been transported to America by this time with the creation of the Diocese of Baltimore in 1789 (later named an Archdiocese in 1808). Use of "mass media" by the Church was inaugurated with the introduction of the first Catholic newspaper in the United States in the early 19th century.

In keeping with the times in the 1920's, Catholics employed the modern technology of radio to reach mass audiences. In 1930, the National Council of Catholic Men sponsored the weekly "Catholic Hour" radio series.

Religious television was a natural carryover from religious radio. Archbishop Fulton J. Sheen began radio broadcasting in 1928 and continued to spread the Word through national television when he was approached by a commercial network to present a regular TV program which was commercially sponsored.

Today, the Catholic Church in the United States has at its disposal state-of-the-art technology to communicate not only with the masses, but to reach the many sub-organizations and agencies which comprise its own infra-structure.

The Catholic Church is organized into autonomous geographic units called dioceses. Within these dioceses are a myriad of agencies whose activities revolve around conducting specific aspects of Church function within the local community. Further, the people who dedicate their lives to the Church and to God, men and women religious, are organized into national orders whose membership seeks to fulfill a particular aspect of the Church's ministry to its people.

And finally, a host of associations and an incorporated business entity, the United States Catholic Conference, address their attentions to conducting the Church's business within the world-at-large.

In the late 1970's a feasibility study was commissioned to ascertain exactly what the communications needs of the Church were and how they might best be met. It was determined that the Church was conducting communications of a sufficient variety, frequency, scope and complexity to warrant the creation of a delivery system to be operated by the Church for these communications.

By creating a national telecommunications system specifically for the Church, precious financial and human resources would be organized and unified to maximize cooperation, collaboration and, therefore, results. Many dioceses and Church-related agencies had already been using electronic media to accomplish their goals. The existence of a national satellite-mediated delivery system minimizes duplication of production by those producing materials locally, as well as ensuring that these materials are available to those unable to produce for themselves.

Hence, in 1981, the Catholic Telecommunications Network of America (CTNA) was created. To date, 95 dioceses across the country have joined the Network, becoming Affiliates. Of these Affiliates, 74 are equipped with at least one downlink and receive CTNA's signal.

The mandate set up for CTNA was to provide telecommunications facilities at the disposal of the Church. CTNA's services include consultation to Affiliates and prospective Affiliates, radio and television programming, teleconferencing, technical support services and Electronic Mail.

The structure of CTNA is that Catholic dioceses and institutions join the Network, becoming Affiliates. At each Affiliate's discretion, they equip themselves with the necessary hardware to receive CTNA's satellite-distributed services. This equipment includes a downlink, decoder with which to decode CTNA's encoded television programming, and downloader, computer and software to receive and capture Electronic Mail materials.

II. A Description of CTNA's Electronic Mail System

A standard Kaypro two disk drive personal computer with 64K of memory is currently being used as both the transmit and receive system. Data is sent from the transmit Kaypro via the RS232 communications port. The data is then processed by a digital-to-analog conversion system such as is found in high speed telephone modems. The data rate is 1200 baud. The resulting analog signal is then amplified, filtered and sent out of the conversion system as a balanced 600 ohm analog audio signal. This audio is then sent to the uplink facility and modulated onto a 6.8 MHz satellite audio subcarrier.

The received 6.8 MHz signal is demodulated at the receive site and processed as a standard analog audio signal. The analog signal at this point can either be distributed throughout the receive site using an audio distribution amplifier or remodulated and sent locally via a local area network, cable system or microwave system.

When the audio signal reaches its final destination (the receive Kaypro), it is fed into another conversion system (downloader) which converts the data back to a standard RS232 digital signal. At this time, the converted signal is sent to the receive Kaypro's RS232 modem communications port.

The transmit and receive software utilize a modified Bell 212 Protocol written in Pascal. However, unlike normal modem operation which relies on a "handshaking" process between connecting systems, this modified software incorporates a multiple block transmission procedure with error checking and sampling performed by the receive software.

The transmit software "system" diskette is placed into Drive A of the transmit Kaypro. The system diskette contains files necessary for transmission as well as date scrambling. The data diskette containing the information to be sent and previously assembled using standard word processing procedure is placed into Drive B. The transmit date diskette containing the file or files to be sent is, as mentioned, a standard word processed diskette with one exception: the first line of the text of each file is what we term a "header" line. The header line is an ASCII code of up to 108 characters. Each header uniquely identifies not only the file being transmitted but also contains information as to who is authorized to receive the transmitted data. The transmit system diskette reads the header information apart from the rest of the file. The reason for that is that the system diskette transmits the header up to 10 times before transmitting the file itself. By multiple transmissions of the header, it gives each receive unit time to sample the incoming data, determine if it is authorized to receive the information and subsequently go into a capture mode. After the header has been sent, the transmit system starts sending the file. The file is sent in 132-byte blocks. Each block is sent a total of three times. The receive system reads each incoming block of data separately, compares each of the three blocks and stores one of the two blocks it finds to be most alike. As the receive Kaypro becomes full it periodically writes what is in memory onto a blank formatted diskette in Drive B. This diskette is now ready for processing by standard word processing procedures.

The transmission system will pass to the receive site any printable ASCII character or control code, even graphics. There is one precautionary measure which must be observed when sending graphics and control codes. The receive site must process this particular type of information using the same version of processing software by which it was originally created (i.e., control codes created using Wordstar cannot be processed at the receive site using Perfect Writer, etc.). However, if both sites are using the same type of processing software, almost any type of data may be transmitted, including but not limited to programs, spreadsheets and multi-dimensional arrays.

As an overview, Electronic Mail is a quick, easy and cost-effective means by which to send information to multiple sites over great distances.

III. Successes Enjoyed, Problems Encountered

Uses to date of CTNA's Electronic Mail service include a daily update of broadcast schedules, with running times given for each program distributed. CTNA has received data and correspondence from one Affiliate with instructions to send these materials to another Affiliate or group of Affiliates. Special announcements such as sunspot effects per site, teleconference announcements and upcoming spacecraft changes have been sent via Electronic Mail, maximizing the amount of time those Affiliates have had to prepare to deal with these events.

During CTNA's annual live gavel-to-gavel coverage of the week-long National Conference of Catholic Bishops/United States Catholic Conference General Meeting in Washington D.C., Electronic Mail has made it possible to send last-minute agenda changes to Affiliates viewing the coverage and giving access to local media.

Concurrent with CTNA's distribution of teleconferences, supplemental materials such as work sheets, feedback survey forms, and applicable information has been distributed to participating sites.

Many future applications of CTNA's Electronic Mail technology are now becoming apparent. The Public Affairs Office of the United States Catholic Conference plans to distribute all Press Releases and mailings to Bishops via CTNA's Electronic Mail, expediting the dissemination of important information and Church developments.

CTNA's Affiliates are in the process of creating an Affiliate Bulletin Board whereby they will be able to input information on equipment for sale, endeavors in progress, and personnel positions available for all Affiliates to access, bypassing the steps and time necessary to accomplish national reception of such information by conventional means.

CTNA's Field Engineering personnel tour the country installing new downlinks as well as maintaining existing ones. Via Electronic Mail, CTNA headquarters can communicate with these crews for purposes of office business, procedures updates, site survey and computer cull analyses, as well as Network developments in other parts of the country that Field personnel would not otherwise receive.

Other Church agencies have expressed interest in utilizing CTNA's Electronic Mail technology. The Catholic Television Network, a group of Catholic ITFS licensees, plans to interact via Electronic Mail, having already used satellite technology to conduct their business when they held a national teleconference for their members recently.

National religious orders and Catholic communications organizations have also expressed interest in employing the technology available through CTNA.

CTNA's Electronic Mail project has proven effective to date in alerting Network membership to last-minute developments of a timely nature. Because the Network, numbering at 95 and growing, is too large to make dissemination of crucial information by telephone feasible, Electronic Mail is fast becoming the only means of assuring Affiliate awareness.

The availability of the Electronic Mail technology has brought about a change in the delivery of the National Catholic News Service to its subscribers. NC News, the Catholic equivalent of UPI and AP wire services, began delivering its daily feeds by satellite early in 1986, as a third delivery alternative to its constituency. Subscribers can choose teletype, postal service or satellite delivery of daily news feeds. The availability of NC News through CTNA has attracted new customers to the NC News service.

Despite the success of its utilization, the implementation of this new technology has not proven wrinkle-free. CTNA will have to acquire a third audio subcarrier over which to send the Electronic Mail signal. Affiliates will have to become equipped to receive this third audio subcarrier since CTNA, to date, used only two and therefore, installed only the two subcarrier modulator boards necessary in its Affiliate downlink receivers.

In addition, the technical expertise of personnel operating Electronic Mail receive sites runs the gamut from technology novice to full-fledged engineer. Therefore, on any given day, not all receive sites successfully capture the day's Electronic Mail transmissions due to a myriad of operator errors. CTNA must then retransmit missed feeds for the benefit of those sites, requiring telephone calls to and from the sites and CTNA headquarters to coordinate the timing of retransmissions so as not to interfere with regularly scheduled feeds. As new sites equip themselves for Electronic Mail, much telephone time must be spend on supplemental individualized installation instructions for the equipment as well as detailed, step-by-step operating procedures.

Local atmospheric conditions and minor terrestrial interference have proven enough to interrupt or distort the flow of the delicate, critical portions of the satellite signal, causing a given site to receive garbled information, partial reception, or no reception at all.

The computer software required to transmit and receive Electronic Mail has required de-bugging and refinement.

And finally, because problems may have any number of causes, diagnosis of a site's difficulties has been trying, requiring patience on both the user's and CTNA's part. At times, the service may appear erratic because the success rate of CTNA-to-Affiliate transmit/receive/capture/access is not always 100%.

CTNA has marketed this new service to its Affiliate constituency with mixed results. Some Affiliates who tend to be protagonists of technology and comfortable with it in general have equipped themselves for Electronic Mail reception and have been pleased with the results. Other Affiliates have become Electronic Mail capable only to find it a source of frustration because they don't fully understand the technology involved and find it a chore to operate. And yet other Affiliates take a skeptical wait-and-see stance, wanting proof-positive that the service is worth the investment. Because not all Affiliates are Electronic Mail capable, CTNA must still employ traditional means of information dissemination such as telephone and postal service, causing time-consuming duplication of work and financial commitment to a greater number of communications vehicles than would be necessary if all Affiliates were Electronic Mail capable.

CTNA has sought to overcome Affiliate apathy towards the service by creating specific incentive programs such as equipment discounts, service fees price breaks and special offers, but with only a modest success to date.

Like the missionaries undaunted almost 400 years ago, CTNA will not allow adversity to impede progress towards the goal of the Catholic Church in the United States unified and strengthened through modern communications.

The Study for an Advanced Use of Satellite Communication
-- The Development of the Distributed Videotex Data Base Retrieval System Using Satellite Communication --

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1. Abstract

We developed the distributed videotex data base retrieval system using satellite communication, and made an experiment of the system using CS-2 (Communication Satellite-2; Japanese domestic satellite). This paper reports the results of the experiment, and describes what method is applicable for the retrieval of data bases extended to many places using satellite communication.

2. Introduction

Since a CS (Communication Satellite) was launched in 1977, Japan has entered the satellite communication era.
CS-2 (Communication Satellite-2), launched in 1983, is now in operation, and another three communication satellites (CS-3, and two satellites to be operated by two new common carriers) are scheduled to be launched in 1988. Satellite communication is expected to enter a new phase.

CS-2 has been used mainly by NTT (Nippon Telegraph and Telephone Corp.) and government offices to back up ground circuits when disaster occurs, establish communication with isolated islands, and construct temporary circuits. Furthermore NTT has been operating satellite communication services using CS-2 since 1985.

The Ministry of Posts and Telecommunications, another CS-2 transponder owner, has used the CS-2 differently. The Ministry has promoted a project called "CS-2 Pilot Program" since 1983 to learn how to use satellite communication systems. The Ministry of Posts and Telecommunications has given those companies, interested in utilizing satellite communication, the opportunity to experiment with them. As of July 1986, more than 50 companies had joined the CS-2 Pilot Program.

Fujitsu has taken part in the CS-2 Pilot Program since 1983, and conducted many experiments applying satellite communications to evaluate them under the guidance of the Ministry of Posts and Telecommunications. The experiments conducted so far include file transmission between computers, time-sharing systems, corporate banking using personal computers, backup of terrestrial circuits between terminals and the host computer of a bank, and teleconferencing.

This paper describes the development of the distributed videotex data base retrieval system using satellite communication, which is an experiment with an advanced use of satellite communication.

3. Background of experiment in distributed videotex data base retrieval

As the amount of information increases and improved communication networks are constructed, Japan is moving to distributed data bases on computer networks to utilize local information more broadly.
Distributed data bases can not only reduce communication costs but also distribute the risks. Especially, financial circles call for distribute data bases.
As the number of local data bases and departmental data bases within companies increases, distributed data base systems with effective retrieval functions are called for.
The trend toward distributed data bases is not limited only to Japan. The needs for systems to retrieve world-wide, distributed data bases will increase, and satellite communications will be used to reduce costs.

Considering the trend above, we built an experimental system to retrieve a distributed data base effectively using CS-2, and evaluated the applicability of satellite communication to this system. We used an image data base of videotex. In Japan, videotex service started in November 1984.

4. Functional requirements for distributed videotex data base retrieval system

We start our discussion with functional requirements for distributed videotex data base retrieval systems.
When more than one data base exists independently, users have to poll sequentially the computers hosting each data base by themselves to find necessary information. Distributed data base retrieval system must have the following features to eliminate this inconvenience. (Figure 1)

(1) Users only need to call the nearest computer within the system when they want some information.
(2) The system having circuits connecting data bases searches for the information required by users in many data bases and provides it to the users.

It is expected that the application of a system with such features will allow the users to save the time needed to retrieve from more than one data base by themselves and to retrieve data at lower cost (especially from remote data bases). Satellite circuits as well as ground circuits may be available for the circuit connecting data bases. Especially for an international system, satellite circuit may normally be used to retrieve from an overseas data base. And as domestic satellite communications are used more and more, a system to connect all data bases with satellite circuits is expected for a system used only within Japan.

5. Object of experiment

We developed a retrieval system for a distributed videotex data base which meet the above functional requirements and conducted an experiment to evaluate the applicability of satellite communication using CS-2. Use of satellite communication generates 0.25 second of delay compared with the use of a ground circuit. This means that a minimum of 0.5 second longer than for a ground circuit is required when users use a satellite circuit for data base retrieval. When required data is searched for in many data bases, a retrieval system which sends and returns messages by the satellite circuit several times multiplies the effect of delay caused by satellite, which may result in impracticability.

So the retrieval system must be carefully selected for a distributed data base which uses satellite circuits.

This experiment was intended for the following two items.

(1) Subjective evaluation of effect on users caused by satellite delay.
(2) Analysis of retrieval system to minimize the effect caused by satellite delay.

6. Experiment system

Figure 2 shows a system chart of this experiment.

We used two computers located in Tokyo and Akashi (a city in the Kansai area) and prepared three videotex data bases, one in Tokyo and two in Akashi. We installed an earth station having an antenna 5 meters in diameter in Tokyo and Akashi, and connected two computers with a satellite circuit.
We used part of the CS-2 transponder (6 MHz bandwidth) for the satellite and set up a full duplex line of 1.5 Mbps. In the experiment, this physical satellite circuit was multiplexed by timesharing. The logical circuit for this system is 48 kbps full duplex between Tokyo and Akashi. For data communication with a satellite circuit, satellite delay can generate response wait even if HDLC procedure is used. But in this system, the parameter value of transmission control is set to prevent response wait. (See Table 1). Bandwidth used was Ka band (30/20 GHz), rain did not fall on the day the experiment was conducted and we confirmed that circuit quality was better than BER 10^{-8}. (BER: Bit Error Rate).
We used CAPTAIN terminal (designation of the videotex standard in Japan) to retrieve data and connected to the computer in Tokyo through the ground telephone network to retrieve image. Communication rates were 75 bps up (terminal to telephone network) and 4800 bps down (telephone network to terminal).

Outlines of experiment system and conditions are shown in Table 1.

7. Experiment method

We measured time from input of screen number through CAPTAIN terminal to appearance of image and time to complete display of image. A stopwatch was used for measurement and subjective evaluation was also conducted by an experimenter actually looking at the image.

The image data used for experiment had a data quantity of about 1 kbytes to 12 kbytes and images were blocked and transmitted every 3500 bytes. Figure 3 shows an example of data used in experiment (quantity of data 1045 bytes, 2766 bytes). Actual image is colored. The images of CAPTAIN system now used in Japan are said to be from 1000 to 4000 bytes usually per image.

8. Results of experiment

As mentioned above, this experiment has two objectives. We conducted the following experiments for each objective.

8-1. To what extent the effect of single-hop satellite delay is irritating to users?

We compared two image retrievals, one that used a satellite circuit and one that did not, for data base retrieval between two points (Figure 4). In this experiment the same data bases were prepared in Tokyo and Akashi, either data base was selected to retrieve an image, and response time (time from input to appearance of image and complete display of image) was compared.

Experiment result is shown in Figure 5.
The experiment showed that the time from input to appearance of image and complete display of image had a difference of about one to two seconds between those retrievals that used the satellite circuit and those that did not. According to the subjective evaluation by the operators, the effect caused by delay was small enough to ignore. (Five person actually experimented terminal operation.) (Time from input to appearance of image are almost all equal when the quantities of image data are more than 3500 bytes. This is because, if the quantity of data exceeds 3500 bytes, data quantity

of the first block becomes equal to 3500 bytes as images are blocked and transmitted every 3500 bytes.)

This result shows that when data base volume data such as a videotex image is retrieved, the effect caused by satellite delay can be ignored for a single-hop satellite circuit. But in an actual system, the data bases may be distributed in many areas, so some retrieval system require more than two hops to output the image to the terminal. In this case, the effect caused by satellite delay are multiplied so that it can irritate the retriever. For data base retrieval from many places, improvements to the retrieval system to minimize the time of utilizing satellite circuits is required.

8-2. What method is applicable for data base retrieval extended to many places?

Various methods can be considered for the retrieval of distributed data bases. One methods is to select a computer having required data by reading the directory of all data bases and to ask that computer to process data. But in this method, each computer is needed to have same directory, so management of the directory, especially batch management, and update of the directory are not easy.
This time, we used a system to poll each computer for the required data without using directories. In detail, that method is to input the code number of required data from terminals and the system which received the code number polls each computer for data with that number. If any computer has the required data, the system asks that computer for processing. In this case, the content of data base at each location, including the above mentioned directory, are not required to match, so system management is easy.

Following is a discussion of the inquiry system. Two kinds of inquiry system can be considered. One is the method of sequentially poll each data base, called "Serial Retrieval" and the other is the method to simultaneously poll each data base called "Simultaneous Retrieval". (Figure 6). When a ground circuit is used between data bases, easily processable serial retrieval may be usually used. When serial retrieval is used during use of a satellite circuit, response becomes very slow due to the effect of satellite delay every time the next data base is accessed. So in the system in which data bases distributed in many places are polled using a satellite circuit, simultaneous retrieval is considered to be applicable.

To verify this, we have developed a serial retrieval system and a simultaneous retrieval system to conduct a experiment for measuring response time when using a satellite circuit. But as we could use only two earth stations as shown in Figure 2, we simulated a condition of many locations as follows. The network simulated is shown in Figures 7 and 8. We assumed computers are located in three places and data bases only in two places (B & C). Data flows are as follows. A telephone call is placed from the terminal to the nearest computer A, and Computer A asks computer B or C for image retrieval processing. In serial retrieval, computer A asks computer B for retrieval. If computer A could not find the necessary data in computer B, then it asks computer C. In simultaneous retrieval, computer A asks both computer B and computer C at the same time, and it outputs the image which returns first to the terminal.
We hope you can understand the above mentioned data flow simulated in upper charts of Figures 7 and 8.

A part of experiment results is shown in Figure 9. Figure 9 is the comparison of time from input to appearance of image between serial retrieval and simultaneous retrieval. As mentioned before, the data retrieval sequence of serial retrieval is B, then C. As the graph shows, if any data exists in data base B, serial retrieval has faster response than simultaneous retrieval. This is because serial retrieval can be more easily operated than simultaneous retrieval. But if the data does not exist in data base B, response of serial retrieval became a little less than one second slower due to the effect of satellite delay, while response time of simultaneous retrieval remained the same. In fact, the response time of simultaneous retrieval became faster than that of serial retrieval. This proved validity of simultaneous retrieval when data bases existing in two distant places are searched using satellite circuits (for example, when people living in Hawaii search data bases located in Tokyo and San Francisco using satellite circuits). It is expected that if data bases are located in many more places, the superiority of simultaneous retrieval will be furthr enhanced.

9. Conclusion

We conducted the experiment mainly to find measures against delay caused by satellite, and obtained the following two conclusions.

(1) When videotex is retrieved, effects caused by the delay of satellite circuits can be ignored for one hop via satellite.
(2) When data bases are distributed in many places, the system which retrieves data bases sequentially is affected greatly by the delay of satellite circuits, resulting in slow response. If you use the newly developed system to search more than one data base simultaneously, you can minimize the effect of satellites.

As users require more and more information, the requirement for retrieval of data bases hosted in foreign countries is expected to increase. A data base retrieval system between countries cannot be operated without using satellite circuits, but what measures should be taken may be a big problem. The above conclusion obtained by the experiment is considered to have paved the way for practical development.

This experiment was centered on measures against delay which is a demerit of satellite communication. Better utilization of the merits of satellite communication will be of importance. Some idea such as simultaneous broadcasting of the code number of the required data to each earth station will allow the users' requirement, retrieval of distributed data bases, to be practically at low cost.

As we mentioned at the beginning, we have been conducting many experiments concerning the application of satellite communication. As a result, we reached the conclusion that satellite communication is applicable for most applications (except Time Sharing System with many terminals) if some conditions are met.

In 1988, another three satellites will be in operation in Japan. Fujitsu will make the best use of the result obtained by experiments with the CS-2 Pilot Program and develop an integrated satellite communication system to meet users' requirement.

10. Acknowledgment

We make a most cordial acknowledgment to the Ministry of Posts and Telecommunications which gave us the chance to try satellite communication and gave us the guidance for experiments in satellite communication, and THE DAI-ICHI KANGYO BANK, LTD., C.ITOH & CO., LTD., THE BANK OF TOKYO, LTD., NISSHO-IWAI CORPORATION, and FUJITSU FACOM INFORMATION PROCESSING CORP., which conducted various experiments with us.

Table 1 Experimental system and experimental conditions

Experimental system

Satellite CS-2 : Ka band transponder 20% used

Earth station

Antenna : Cassegrain type , 5m dia.

HPA : TWT (20W)

LNA : Electric-cooled microwave low-noise HEMT

Noise temperature (160K)

(HPA : High Power Amplifier , LNA : Low Noise Amplifier)

Satellite circuit

Transmission speed : 3.088Mbps

Error correction : Rate 1/2 convolution error correction

Operation mode : Continuous mode

Experimental conditions of data communication

Tokyo computer to Akashi computer

Transmission speed : 48kbps

Protocol : HDLC (NRM)

Number of outstandings : 7

Frame length : 1043 bytes

Terminal communication speed

Upstream (terminal to telephone network) : 75bps

Downstream (telephone network to terminal) : 4800bps

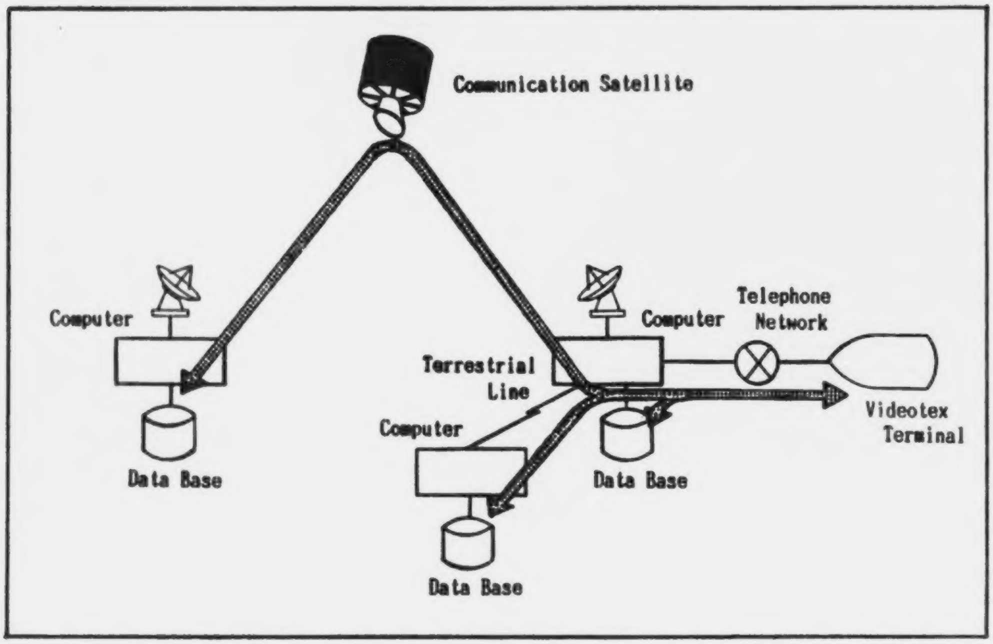

Communication Satellite
Computer
Computer
Telephone Network
Terrestrial Line
Computer
Videotex Terminal
Data Base
Data Base
Data Base

Figure 1 Features of distributed videotex data base retrieval system.

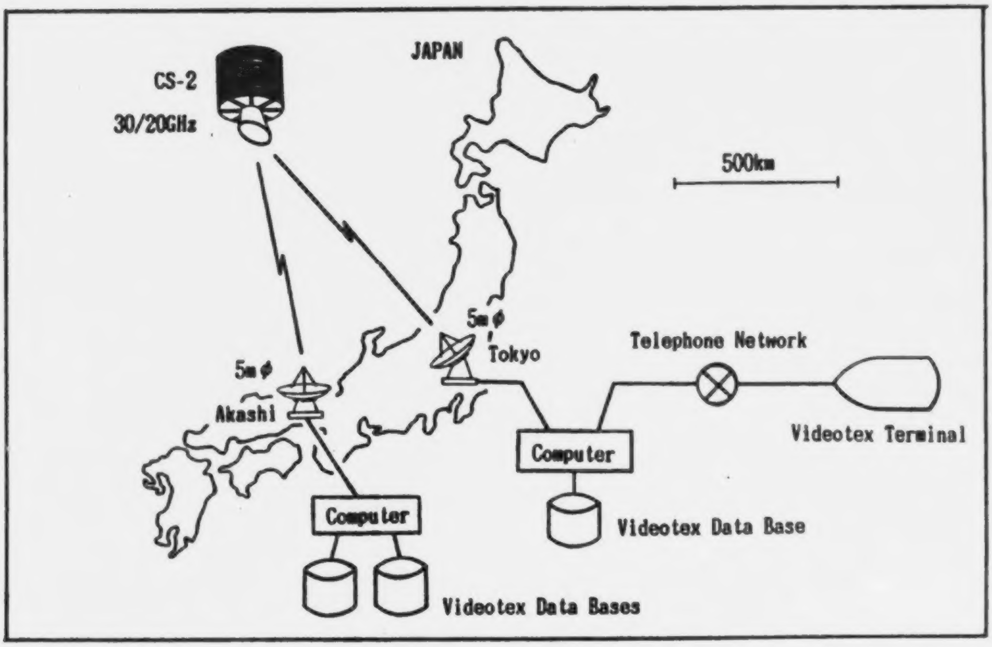
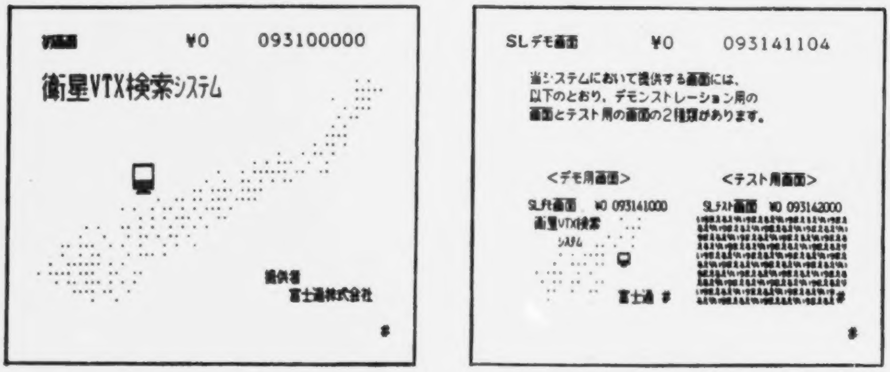

JAPAN
CS-2
30/20GHz
500km
5m φ
Tokyo
5m φ
Akashi
Telephone Network
Videotex Terminal
Computer
Computer
Videotex Data Base
Videotex Data Bases

Figure 2 Sketch of experiment system



[illegible] ¥0 093100000

衛星VTX検索システム

提供者
富士通株式会社

#

SLデモ画面 ¥0 093141104

当システムにおいて提供する画面には、
以下のとおり、デモンストレーション用の
画面とテスト用の画面の2種類があります。

<デモ用画面>

SLデモ画面 ¥0 093141000
衛星VTX検索
システム
富士通 #

<テスト用画面>

SLテスト画面 ¥0 093142000

#

Quantity of image data
: 1045 bytes

Quantity of image data
: 2766 bytes

Actual image is colored.

Figure 3 An example of image used in this experiment.

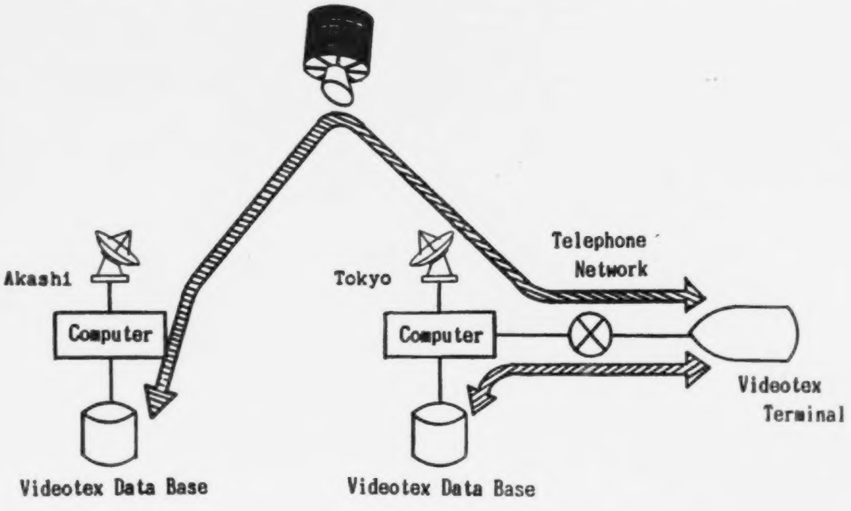

Telephone
Network
Akashi
Tokyo
Computer
Computer
Videotex
Terminal
Videotex Data Base
Videotex Data Base

Figure 4 A sketch of experimental configuration to examine the effect caused by satellite delay.

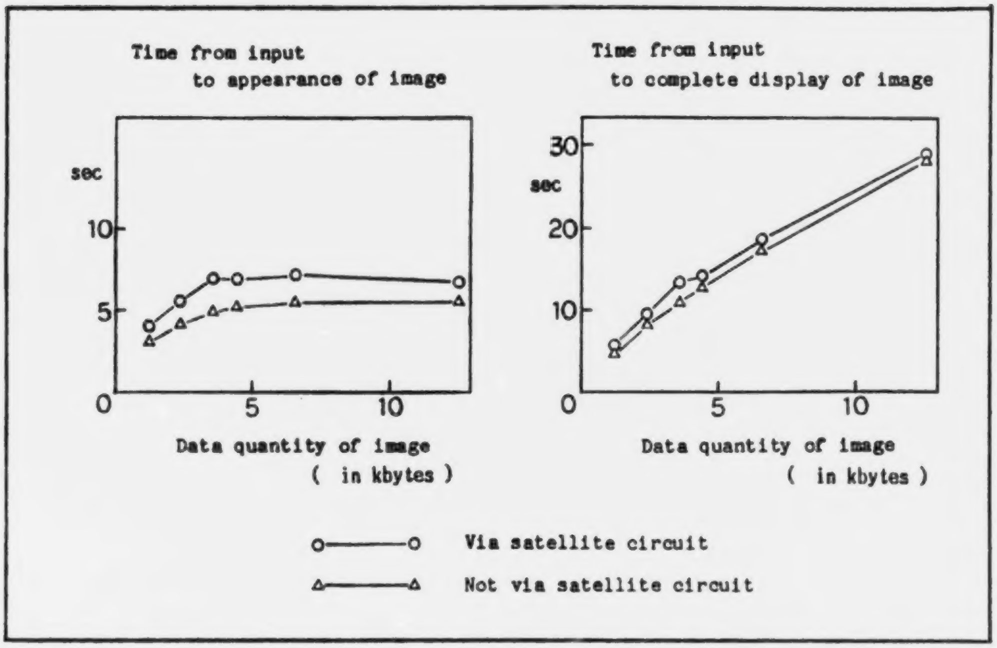
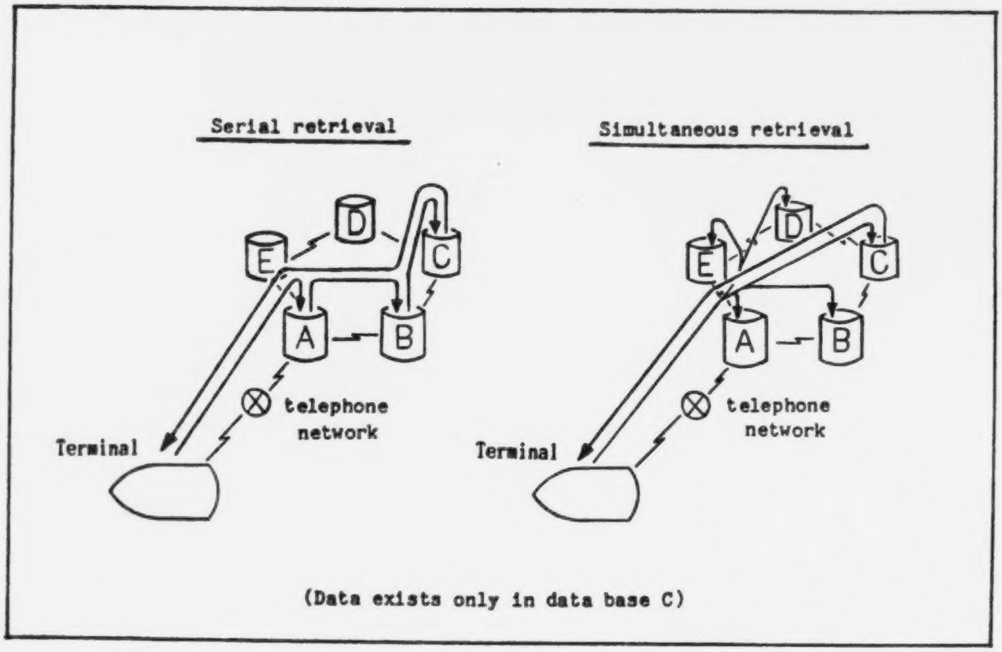


Figure 5 Effect of satellite delay on response time of image retrieval


Serial retrieval
Simultaneous retrieval
A
B
C
D
E
telephone network
Terminal
A
B
C
D
E
telephone network
Terminal

(Data exists only in data base C)

Figure 6 Comparison of distributed data base retrieval systems

(Serial retrieval & simultaneous retrieval)

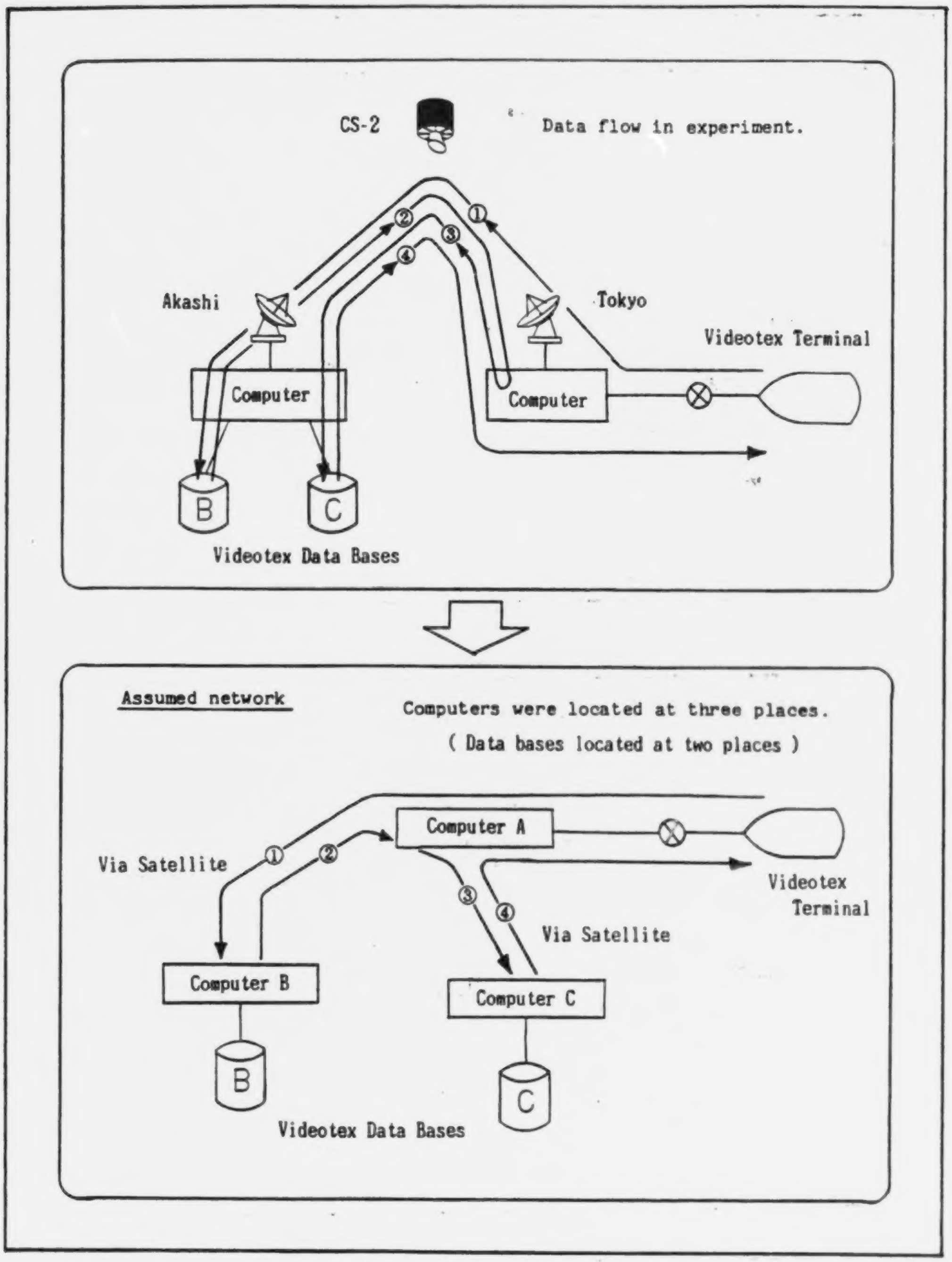

CS-2
Data flow in experiment.
①
②
③
④
Akashi
Tokyo
Videotex Terminal
Computer
Computer
B
C
Videotex Data Bases
Assumed network
Computers were located at three places.
(Data bases located at two places)
Computer A
Via Satellite
①
②
Videotex
Terminal
③
④
Via Satellite
Computer B
Computer C
B
C
Videotex Data Bases

Figure 7 A sketch of experiment system for three assumed places.
Data flow when serial retrieval system is used.

(Required data exists only in data base C)

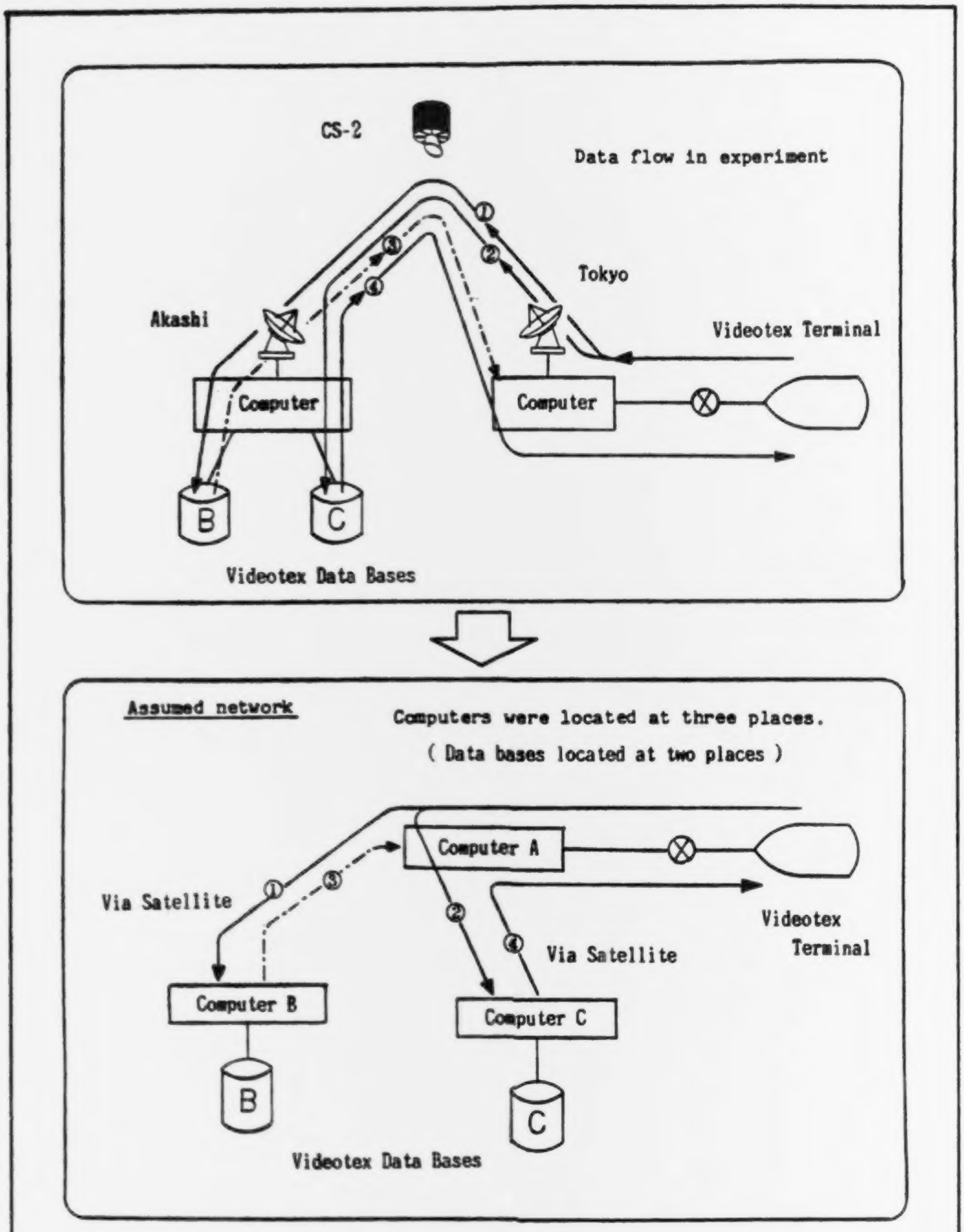

CS-2
Data flow in experiment
①
②
③
④
Tokyo
Akashi
Videotex Terminal
Computer
Computer
B
C
Videotex Data Bases
Assumed network
Computers were located at three places.
(Data bases located at two places)
Computer A
Via Satellite
①
③
②
④
Via Satellite
Videotex Terminal
Computer B
Computer C
B
C
Videotex Data Bases

Figure 8 A sketch of experiment system for three assumed places.
Data flow when simultaneous retrieval system is used.

(Required data exists only in data base C)

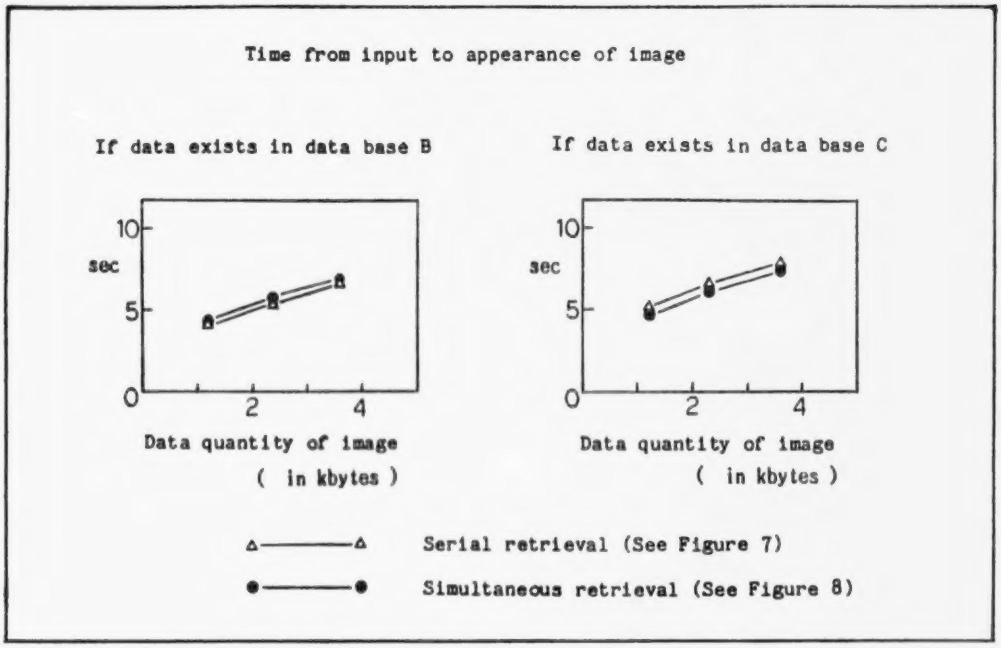


Figure 9 Comparison of retrieval system when distributed data bases are searched using satellite circuit

LUNCHEON

Keynote Address

"Services to Users World-Wide in a Changing Telecommunications Environment"

Anthony J. Booth, Corporate Director
British Telecommunications PLC and Managing Director,
British Telecom International

Notes

Working Groups

PATENTS, COPYRIGHTS AND TRADE SECRETS AS APPLIED TO TELECOMMUNICATIONS IN THE UNITED STATES

Stephen E. Baldwin
Henry K. Woodward
FLEHR, HOHBACH, TEST, ALBRITTON & HERBERT
San Francisco, California

ABSTRACT

This background paper generally describes aspects of patents, copyrights and trade secrets in the United States applicable to telecommunications. In the United States, patents and copyrights are based on Federal law, while trade secrets are based on state law.

PATENTS

The basic right granted by the United States Patent Statute (Title 35, United States Code) when a patent issues is the right to exclude others from making, using or selling the invention throughout the United States for the term of the patent - seventeen years from the date of issuance. This right to exclude is not by any means an absolute, as frequent disposition of an alleged patent infringement matter is by negotiating some form of a license agreement.

Also, the right granted by the issuance of a patent does not mean that the patentee has the right to make, use or sell his own invention. Rather, the patentee may have to address the question of an unexpired, dominant patent. A dominant patentee may preclude another patentee from practicing his own invention without first obtaining express permission of the dominant patentee.

The U.S. Patent Statute expressly provides that whoever invents or discovers any new and useful process, machine, manufacture or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of the Patent Statute (35 U.S.C. §101). Hence, virtually all aspects of a telecommunications system (or components thereof) may be patentable, provided the basic requirements of novelty, utility and non-obviousness of the subject matter are met. In addition, a complete disclosure of the claimed invention is required as part of the basis of seeking the patent grant. Each of the aspects of what is required for seeking a patent in the telecommunications art will now be discussed.

One requirement which is generally the easiest to assess is that the subject matter must be novel. The aspect of novelty is simply that which is sought for patent protection in the United States must in fact be new. Stated otherwise, a person shall be entitled to a patent unless the invention was known or used by others in the United States, or patented or described in a printed publication in the United States or in a foreign country before the invention by the applicant for patent, or the invention was patented or described in a printed publication in the United States or a foreign country or in public use or on sale in the United States more than one year prior to the date of application for patent in the United States (35 U.S.C. §§102(a) and (b)).

There are other requirements of novelty which are set forth in detail in 35 U.S.C. §102. One general principle with respect to the novelty requirement is that an application must be filed in the United States Patent and Trademark Office (PTO) by the applicant no later than one year after disclosure by publication or commercialization of the invention. Otherwise, the applicant's own activities become prior art and hence there is no novelty for the specific subject matter. Commercialization can occur such as with the first sale of the invention (regardless of the complexity of the telecommunications system), showing of the completed invention at a trade show, or even offering for sale of the completed invention. Hence, the novelty requirement for a patent in the United States can be negated either by the commercial activities of others or by an applicant's own activities, if an application is not filed in the United States Patent and Trademark Office (PTO) within one year after first commercialization of the invention.

A second requirement for patentability is utility. The telecommunications system must serve a utilitarian purpose, which, in general, is easily satisfied. However, in the telecommunications art, there are two basic inquiries with respect to whether the particular subject matter satisfies the utility requirements of the United States Patent Laws.

The first inquiry is whether an applicant is seeking to claim a purely mathematical algorithm (e.g., such as a Fast Fourier Transform). It is clear that attempting to claim a purely mathematical algorithm in seeking patent protection is not permitted in the United States. Hence, a Fast Fourier Transform, a Discrete Cosine Transform, or any other purely mathematical algorithm cannot be the proper subject matter of a United States Patent. However, the combination of a mathematical algorithm in conjunction with some other component, as utilized in a telecommunications system, might be satisfactory for purposes of seeking patent protection. As an example, the novel combination of a Fast Fourier Transform with a particular weighting network for transforming between frequency division multiplexed and time division multiplexed formats in a telecommunications system may indeed be patentable (e.g., see U.S. Patent No. 4,237,551).

The other inquiry regarding the utility requirement of a United States patent is in the field of computer software. The PTO is currently issuing patents which relate to software controlled applications. Whether a United States patent will be upheld which in its disclosure is purely a computer program remains a gray area. The ultimate disposition of such "software" patents in the United States have to be arbitrated and decided, either by the Congress or by the courts. However, telecommunications systems which incorporate a computer software aspect are being issued at the present time, and the general recommendation is for users of such telecommunications systems to consider these aspects of patenting the particular subject matter.

One reason for the unclearness of the patentability of computer software is essentially a philosophical one between the term of a patent and that of a copyright. The term of a patent is 17 years, while the term of a copyrighted work of art is the life of the author plus 50 years (or, for a work for hire, the term is 75 years). The reasoning is that once a patent has expired, the subject matter in general is dedicated to the public domain. The argument is that if the computer software is permitted to have both patent protection (17 years) and copyright protection (say, the life of the author plus 50 years), there is effectively an extension of the patent grant beyond the 17 year term. Again, this utility aspect of computer software has not been finally decided. It should be kept in mind that in the telecommunications art, computer software control is an important aspect and the users of such telecommunications systems should nevertheless consider any possible patentable aspects.

The most difficult aspect of patentability, in general, is whether the particular subject matter is non-obvious. The claimed subject matter for which patent protection is sought must be evaluated under a three-part test, which is:

1) The scope and content of the prior art are to be determined.

2) Differences between the prior art and the claimed invention are to be ascertained.

3) The level of ordinary skill in the pertinent art resolved.

Against this background, the obviousness or non-obviousness of the subject matter is determined. Further, secondary considerations such as commercial success, long-felt unresolved needs, failures of others, etc., can be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

A final aspect regarding patentability which should be discussed is the requirement of a full, clear, concise and exact disclosure to the Patent and Trademark Office of the claimed invention. In the telecommunications art, a full disclosure of the invention, (again, for example, a telecommunications system) might be satisfied by only submitting block diagrams of a particular system. However, if certain elements of the invention require a more detailed disclosure for a clear understanding to one of ordinary skill in the art, then the applicant for a patent should make sure that, if necessary, logic level diagrams or perhaps even schematic level diagrams are submitted for disclosure purposes. Also, a detailed written specification describing one embodiment is usually required to completely describe the interrelationships of the claimed components which form part of the system.

The patent application must end with one or more claims which recite the patentable aspects of the invention. Each claim is a one-sentence recitation which must distinguish over the prior art while setting forth the functional aspects of the invention considered to be patentable over the prior art. It is the claim language in a patent which provides the scope of protection or coverage. If a claim is construed to "read" upon the prior art, that claim is invalid. Hence, the claim language in any patent is of the greatest importance in seeking patent coverage in the telecommunications industry.

Of course, a full disclosure of the claimed invention might serve to, so to speak, "give away the store" by providing free information to a competitor. A patent is a full description of an invention, and if the claimed invention for patent protection purposes is very narrow, a full disclosure could give free information to others, while still permitting those same competitors to design around the particular claim language.

A user of a telecommunications system should keep in mind that trade secret protection (to be discussed below) may be a more viable alternative than seeking patent protection.

One basic question which should be considered in the telecommunications art is what will a patent do for a particular entity. In order to protect a particular product, the patent right is, as set forth above, the right to exclude others from making, using or selling the claimed invention. Hence, injunctive relief may be available to enforce this monopoly permitted by the United States Patent Laws. An excellent example of what patents can do in terms of injunctive relief is by considering the Polaroid v. Kodak patent litigation. Although Polaroid Corporation required ten years in order to have its "day in court," it eventually succeeded in obtaining injunctive relief in order to enforce several of its patents against Kodak. Kodak was taking a calculated business risk when it decided to enter the instant camera market, and as of January 1986 Kodak was completely out of the marketplace.

In addition, a patent can give the patentee the right to recover damages, profits and, in some circumstances, attorneys' fees (typically for willful and wanton infringement). Because of these possibilities, users of telecommunications systems should be cautioned to consult patent counsel before entering into the marketplace with a new product.

A patent can also provide bargaining position in terms of seeking a suitable cross-license agreement with some other patentee. For instance, suppose a user develops an improvement on an existing dominant patent. If that user wants to be able to get into the marketplace with the dominant patent holder, the patented improvement may be the basis of negotiating a suitable cross-license agreement which permits both entities to practice the other's invention without the threat of a patent infringement suit hanging overhead.

One final general observation regarding the United States Patent Laws concerns the formation of the Court of Appeals for the Federal Circuit (C.A.F.C.), which is the sole court to hear all appeals of patent infringement matters. When a U.S. District Court in San Jose, Chicago or Dallas rules that a patent is valid or invalid, infringed or non-infringed, enforceable or non-enforceable, any appeal is taken only to the C.A.F.C. in Washington, D.C. The C.A.F.C. is upholding United States patents if it determines that there is patentable subject matter and that the applicant has complied with the requirements of the U.S. Patent Laws.

As a result, United States patents are an important factor in any ongoing business concern, including the telecommunications art. Therefore, any telecommunications user should consider the aspects of the United States Patent Laws before venturing into the marketplace with its new product.

COPYRIGHTS

Title 17 of the United States Code covers copyrights. An original work of art is eligible for copyright protection, so long as the copyright notice requirements are met. In general, any work of art can meet the requirements for copyright protection so long as there is originality in the work and some degree of creativity. In the telecommunications art, computer software (including microcode) can be the subject of copyright protection.

In general, the duration of a copyright in a work subsists from its creation, and endures for a term consisting of the life of the author and fifty years after the author's death. One exception is a work for hire, in which the copyright endures for a term of seventy-five years from the year of its first publication, or a term of one hundred years from the year of its creation, whichever expires first. It should be noted that a work does not have to be published in order for a copyright to exist. An unpublished, confidential work can still be protected by copyright.

In order to establish a copyright, one very important requirement is to insure that the copyright notice appears in a reasonable location on the work of art (for purposes of discussion, assume the work of art to be computer software).

The copyright notice includes three essential elements, which are (1) the letter "C" within a circle (or the word "Copyright", or the abbreviation "COPR.", (2) the name of the owner of the copyrighted work and (3) the year of first publication. The phrase "All Rights Reserved" should be included if protection is sought in some foreign countries. In some instances, in connection with certain useful articles, the date of publication can be omitted in the copyright notice. An example of this is with greeting cards, where the year of publication is undesirable if the same type of greeting card is to be used annually.

In order to protect copyrighted works of art (such as computer software), it is the copyright owner's burden to police the work of art. Copyright infringement requires proof of an intent to copy, or at least an inference of an intent. The copyright owner must prove that an infringer had substantial access to the particular copyrighted work of art, and that there is a substantial similarity between the copyrighted work of art and the allegedly infringing work. As an example, in computer software applications in the telecommunications art, an infringer will usually not copy the object code on an item for item basis. An infringer may utilize a different computer language which, in other aspects, is essentially identical to the copyrighted work of art. This has been treated by the courts as similar to a mere translation between, for example, English and German, and the copyright owner has been provided with protection.

The procedural requirement for perfecting a copyright to registration is filing an application for copyright registration with the Registrar of Copyrights in Washington, D.C. This is merely a filling out of an application form and, depending on Copyright Office deposit requirements, at least a portion of the work of art may be required for deposit purposes. Once the copyright registration has been granted, the copyright owner has a basis for bringing a copyright infringement action against an infringer in an appropriate U.S. District Court.

Again, the basic requirement for perfecting copyright protection is to insure that the notice requirement, as indicated above, appears in a reasonable location with the copyrighted work. In computer software cases, the recommended location would be as part of the program itself, either at the beginning or end of the program, and, in addition, the copyright notice should be affixed by a label or tag to a packaged memory chip in which the program is embedded.

The copyright registration need not be perfected (registered) until the owner learns of an infringer of the copy righted work of art (there is a three-year statute of limitations after a claim accrues). However, if the registration is not obtained before the infringer appears on the scene (and assuming that more than three months have passed after first publication of the work of art by the copyright owner), the copyright statute provides for a waiver of statutory damages and attorneys' fees.

This is not a desirable result in a copyright infringement action, for the first reason that attorneys' fees can be fairyly substantial in prosecuting a copyright infringement action all the way through trial and appeal. Secondly, proving damages can sometimes be difficult. The copyright statute provides for statutory damages, which will be awarded whether or not the copyright owner can prove adequage damages in terms of the copy right infringement. However, injunctive relief may still be available.

The basic decision in seeking copyright protection for a telecommunications entity is whether copyright protection is desirable for the work of art (again assume computer software is the work of art) in the first place, or whether it is more desirable to maintain some form of trade secret protection for the computer program (to be discussed below).

Another alternative is to maintain a computer software licensing policy which requires the users of the computer software to be bound by a specific license agreement defining proper use o the computer software. Some entities utilize what is called a "shrink-wrap" or "box-top" license agreement which, by the mere opening of a package, is intended to bind the user to a software licensing agreement. However, this type of license agreement is relatively new throughout the United States. Only Illinois and Louisiana at this time have codified shrink-wrap or box-top license agreements, and legislation has not been enacted in the other states. In such types of license agreements, if they are to be held valid by a court of competent jurisdiction, it would be incumbent on the copyright owner to be sure that the intended user of such an agreement has reasonable notice of the general terms and that the terms of the agreement appear prominently thereon, so that the potential user is aware of the consequences of opening the package in the first place.

Legislation was enacted in 1984 by the U.S. Congress to provide protection for semiconductor chip products, which are defined as any product having two or more layers of metallic, insulating or semiconductor material, deposited or otherwise placed on or etched away or otherwise removed from, a piece of semiconductor material in accordance with a predetermined pattern, and intended to perform electronic circuitry functions. The semiconductor chip product act provides protection for a term of ten years from the date of commencement, which is when the mask work is registered, or on the date on which the mast work is first commercially exploited anywhere in the world. The work must be registered within two years after any such commercial exploitation, or else the protection is terminated. The mask work notice consists of (1) the words "mask work," the symbol *M* or the symbol M (the letter M within a circle), and (2) the name of the owner or owners of the mask work or an abbreviation by which the name is recognized or is generally known. The semiconductor chip protection act is a relatively new enactment, and its full consequences on the telecommunications industry is still to be determined. However, it is still another tool which should be considered by any user of telecommunication systems as a means of protecting it proprietary products.

In summary, with respect to copyright protection in the United States, if a telecommunications user desires to seek some copyright protection, the overriding criterion is that a copyright notice, as indicated above, appear in a reasonable location in conjunction with the particular work of art. The failure to provide the copyright notice in general indicates a dedication of the particular work to the public domain. This dedication means that anyone is free to copy the particular work of art which, in many instances, particularly in the development of complex computer software, is highly undesirable.

TRADE SECRETS

Whereas United States patent and copyright laws are based on Federal statutes pursuant to constitutional mandate, trade secret law stems from English common law as applied by state courts and as codified by state legislatures.

Due to the varying interpretations and applications of the common law in the United States, historically there has been a lack of uniformity in the definition of trade secrets and the protection accorded thereto. Thus, a Uniform Trade Secrets Act has been promulgated and enacted by many states.

The definition of a trade secret as set forth in the Uniform Trade Secrets Act is:

"Trade Secret" means information, including a formula, pattern, compilation, program, device, method, technique or process, that:

(i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and

(ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.

Misappropriation is defined as:

(i) acquisition of a trade secret of another by a person who knows or has reason to know that the trade secret was acquired by improper means; or

(ii) disclosure or use of a trade secret of another without express or implied consent by a person who

(A) used improper means to acquire knowledge of the trade secret; or

(B) at the time of disclosure or use, knew or had reason to know that his knowledge of the trade secret was

(I) derived from or through a person who had utilized improper means to acquire it;

(II) acquired under circumstances giving rise to a duty to maintain its secrecy or limit its use; or

(III) derived from or through a person who owed a duty to the person seeking relief to maintain its secrecy or limit its use; or

(C) before a material change of his position, knew or had reason to know that it was a trade secret and that knowledge of it had been acquired by accident or mistake.

The Act provides for injunctive relief and damages as follows:

Injunctions:

(a) Actual or threatened misappropriation may be enjoined. Upon application to the court, an injunction shall be terminated when the trade secret has ceased to exist, but the injunction may be continued for an additional reasonable period of time in order to eliminate commercial advantage that otherwise would be derived from the misappropriation.

(b) If the court determines that it would be unreasonable to prohibit future use, an injunction may condition future use upon payment of a reasonable royalty for no longer than the period of time the use could have been prohibited.

(c) In appropriate circumstances, affirmative acts to protect a trade secret may be compelled by court order.

Damages:

(a) In addition to or in lieu of injunctive relief, a complainant may recover damages for the actual loss caused by misappropriation. A complainant may also recover for the unjust enrichment caused by misappropriation that is not taken into account in computing damages for actual loss.

(b) If willful and malicious misappropriation exists, the court may award exemplary damages in an amount not exceeding twice any award made under subsection (a).

The Act further provides for a limitation period for bringing actions for misappropriation.

Statute of Limitations:

An action for misappropriation must be brought within three (3) years after the misappropriation is discovered or by the exercise of reasonable diligence should have been discovered. For the purpose of this section, a continuing misappropriation constitutes a single claim.

Relief in trade secret actions has been based on contract theory, tort theory, and property theory of law. The contract theory is presented most frequently because of the existence of an express contract or the finding of implied contract between parties. Many cases have expressed the rule that a confidential employment relationship creates a contract implied-in-law barring use and disclosure of trade secrets after employment.

The tort theory has been a popular approach to trade secret law based on the theory of injury caused by the disclosure or use of a trade secret in breach of a confidential relationship. Under this theory, the personal relationship of the parties at the time of disclosure is emphasized, rather than the nature of the information or property sought to be protected. Many states consider misappropriation of trade secrets a tortious action of unfair competition and will allow punitive damages as well as actual damages.

Many states recognize a property right in intangible proprietary information, and state criminal sanctions for misappropriation of trade secrets are based on stolen property. Indeed, in criminal trade secret matters, the knowledge of the defendant that the property has been stolen is a key element of the crime.

In states where trade secret law is not codified, the legal theory for protecting trade secrets is particularly important since the statute of limitations may differ in bringing actions for breach of contract as opposed to seeking relief for torts or invasion of a property right.

In seeking relief for misappropriation of trade secrets, the steps taken in identifying and protecting the trade secrets can be critical. The more valuable the alleged trade secret, the more demanding are the requirements on the owner when seeking relief. Information considered to be a trade secret must be identified, and while marking is not absolutely mandatory, any tangible expression of the information by letter, memorandum, drawing and the like, should be marked as proprietary or confidential information. Access should be limited to sensitive proprietary information such as manufacturing processes and financial data. Employees and others having access to the information should be told that the information is considered confidential and advised as to their obligations in using and protecting the information. These obligations can be expressed in employment and consulting agreements, and reiterated for terminating employees in exit interviews. A company is well-advised to remind new employees that they may have continuing obligations to former employers regarding trade secret information.

Pacific Telecommunications Conference

ALL DIGITAL NETWORKS, AND HOW THE USER BENEFITS

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An all-digital network is one in which all the switching and transmission is digital, even as far as the customer's premises. This extension of the normal arrangement, in which analogue switches are simply replaced by digital machines, has been successfully pioneered by Mercury Communications Ltd. in the United Kingdom.

This kind of network can provide important advantages for users in Government, industry and commerce, who are increasingly coming to rely upon high quality and high speed communications for the conduct of their business. Indeed, it is not too far-fetched to say that the establishment of new financial and industrial centres will depend to a large degree upon the quality of the communication infrastructure, and the far-sighted administration will be including the provision of all-digital services in its immediate plans.

When the ISDN is established, and this will take many years, every subscriber, whether business or residential, will have both a voice and data line simultaneously. However, until that happy time, it will not be economic to provide digital access to every one; what is here being suggested from the experience in Mercury is that there is considerable demand around the world by industry and commerce for new services which can only be carried reasonably by an all-digital network. Thus the network becomes the forerunner of ISDN for a certain class of subscribers, and if a careful purchasing policy is followed, no equipment will be out-dated by the advent of the ISDN.

The most efficient way of providing digital access for a certain class of customers is to implement an 'Overlay' network, which may have its own international gateway.

Using the CEPT heirarchy as an example, in the all digital network the customer is presented with one or more 64Kbit/s lines, which he can choose to use in many configurations, depending upon his particular requirements.

Voice Services

It is still the case with every administration that, whilst data usage is growing rapidly, the predominant service is voice. For switched voice, an all-digital network eliminates the problems of the 'last mile of copper', which in difficult climates can give so much trouble. This is because the digital signals are best fed to the business customer by low capacity microwave, point to multipoint systems, or in a heavily built up area, by Optic Fibre. By this means voice transmission is improved, more than is at first sight apparent, by the elimination of the loss of the copper pair, with a marked effect upon the overall transmission plan. It is usual with an end-to-end digital connection, to plan for an overall loss including hybrids of 10-12dB, which is 15-20dB better than the achievements of analogue networks even in developed countries.

This means that all voice calls on the network are clear, unattenuated and with little noise, with the result that subscribers, once connected in this way, will never wish to return to an analogue connection.

Of course, this state of affairs applies only within the network, and once a call passes into the existing analogue network, the advantages of the digital connection apply only at one end. Nevertheless the benefits are still attractive, but the full advantages will become more widespread as Administrations and users realise the advantages of the end-to-end digital connection.

The range of voice services on the network can make use of all the facilities offered by modern SPC exchanges, such as 'call waiting', short code dialling, and Centrex. This latter service, having been largely confined to the USA in the past, is now gaining wider acceptance, since it can eliminate the need for a PABX in every customer's office.

Data Services

But it is for data services that digital access provides so many advantages. With an analogue 'last mile', data connections are limited to 1.2 or at best 2.4Kbit/s duplex, depending upon the quality of the line. Digital access provides a low-loss four wire connection right into the customer's premises, at speeds up to 64Kbit/s, and beyond if necessary.

Dial-up data calls can be made at these speeds by first using the line as a voice access, and setting up the connection in the usual way, but most data applications are more suited to a leased-line arrangement, which can be provided simultaneously with a switched voice access. There are many possible arrangements, and three are described here to illustrate the wide range available.

1. One 64Kbit/s access can give voice and data access through a multiplexer providing two 32Kbit/s channels. One of these channels can be used for voice, using the latest CCITT ADPCM algorithm. The other 32Kbit/s channel can be used for leased circuit data, by adding a data multiplexer, and then up to 52 lower speed channels can be carried simultaneously.

2. Two 64Kbit/s accesses can provide a channel of 1 PCM voice, or 2 ADPCM voice circuits, with the other channel carrying up to 52 data circuits as before, or three ADPCM voice circuits can be provided together with up to 25 data circuits.

3. For large offices, where many voice channels are required, a 2Mbit/s access is suitable. Here the signalling is carried in time slot 16, and the complete stream can be connected directly to an SPC switch in the public network. In the case of a private network, some channels can be broken down for data use as described above, by the addition of a multiplexer to each 64Kbit/s circuit.

The new services which can be offered once digital access is available include video-conferencing, computer file transfer, photo facsimile, remote newspaper printing, Group IV facsimile and main/slave computer connection at bus speeds.

Access can also be provided to an X.25 switch, to provide a packet switched service. Beside normal data uses, this can carry text transmission in languages other than English, for instance Chinese and Thai, using CCITT Teletex protocols for automatic page transmission between personal computer work-stations.

It is sometimes difficult to estimate the demand for these new services, since the potential users may not yet be aware of the possibilities, but experience in the USA and UK shows that the use of digital data circuits is increasing at a rapid rate, with the large corporate users employing a 2Mbit/s access or equivalent.

INTERNATIONAL

There is no impediment to the immediate creation of worldwide digital networks, since it is now possible to establish an Intelsat IBS earth station in or near a metropolitan area, and in some cases directly in the car park of the company concerned, reducing the local access problem to one of a few hundred metres. Moreover, in large financial and business centres such as New York and London widespread optic fibre networks have been installed to give every important building a high speed access point, and these networks are connected directly to the IBS earth station.

An international voice circuit using all digital techniques is markedly superior in use to one using the existing analogue facilities.This is thought to be done not only to the higher quality and more predictable level of signal, but also to the use of echo cancellers, which provide a duplex circuit at all times, and do not suffer from clipping, and attenuation in the 'double speak' mode, implicit in the use of echo suppressors.

International private data networks are being connected at an increasing rate, once corporate users realise that there is no reason why their equipment in one country need not be connected to branch offices in any other country. We are therefore rapidly entering the era of global networks, where offices around the world are connected as part of one complete system, each one contributing during the period of its working day. Companies can be in instantaneous communications around the world, and computers can be kept up to date with transactions as they occur thousands of miles away.

As this demand for services builds up, both public and private networks will be requiring more bandwidth, and increasingly higher speeds of communication. One such system planned to be in operation in 1989 is the Cable and Wireless Digital Highway, which will consist of submarine optic fibre cables access the Pacific and Atlantic Oceans, with optic fibre connections access the USA.

Administrations and multinational companies can therefore plan their worldwide networks with confidence knowing that the capacity will be available to meet their needs in the next decade.

U.S. TECHNICAL DATA EXPORT LICENSE REGULATIONS AND NATIONAL SECURITY

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Abstract

The U.S. Departments of Commerce and Defense have contrasting views on how the future availability of U.S. technical data should be regulated, both public and private sector data. The DOD views are of particular concern to the U.S. information industry. This paper describes such possible regulatory action and its potential implications on competitiveness, freedom of information and other public policies.

During 1986 two divergent positions emerged within the United States government concerning controls on the export of technical data. A proposal by the Department of Commerce ("DOC") would continue to permit the export of most technical data without a validated export license while preliminary Department of Defense ("DOD") statements based on National Security Decision Directive 145 would restrict it. If implemented, new DOD controls could have a major impact on access to U.S. originated information here in the U.S. and in all foreign countries, not just in Eastern Bloc countries. The DOD proposal would have a chilling effect on the freedom of information in the U.S. Access to and use of many electronic databases and other technical data, as it occurs now, would no longer be possible even in the U.S. Such action would also make it extremely difficult or impossible for technical information to be transferred within a corporate operating network or to a joint venture partner.

Because of the impact on the U.S. information industry and the public interest in freedom of information, DOD must use restraint and common sense in any proposals it attempts to implement. Any actions taken would be unilateral by the U.S. and not in concert with COCOM or under any other multilateral agreement. No such unilateral action can be effective and will only improve the competitive positions of foreign suppliers of electronic data bases and other technical data. If DOD restrictions are implemented, they will also likely restrict the ability of free world nations to acquire information essential to their own economic and technological growth. Such measures will once again shoot U.S. trade in the foot since even our allies will likely use the diminished U.S. presence in the international market to strengthen their own database and other information industries.

BACKGROUND

There are two primary export licensing schemes under U.S. law, the International Traffic in Arms Regulations ("ITAR") administered by the Department of State and the Export Administration Regulations ("EAR") administered by DOC. The Department of Energy and Nuclear Regulatory Commission regulate nuclear related commodities and technical data. Although DOC and ITAR emphasize the export of commodities, they also regulate technical data since information about the functioning or development of commodities can also be strategic. The DOD exerts considerable influence over the requirements of the DOC regulations and DOD licensing decisions.

Export Administration Regulations(1)

Technical Data is defined under the EAR to include information of any kind that can be used, or adapted for use, in the design, production, manufacture, utilization, or reconstruction of articles or materials. The data may take a tangible form such as a model, prototype, blue print, or an operating manual, or they may be in an intangible form such as technical service.

Commodities are only deemed to be exported by actual shipment outside the U.S. In contrast, an export of technical data includes not only the actual shipment of data from the U.S. but also any release of U.S. origin data to foreign nationals, whether within or outside of the U.S. and any release of technical data in the U.S. with the knowledge or intent that the data will be shipped or transmitted to a foreign country. This definition of "export" is also applicable to computer software.

Neither commodities nor technical data may be exported from the U.S. to any country except Canada until an export license is in place, either a general license or a validated license. At present, a general license is available for the export of most technical data to free world countries except for that related to military and nuclear proliferation purposes.

The two general licenses used for the export of software and other technical data are the

General Technical Data Restricted ("GTDR") and General Technical Data Available to All Destinations ("GTDA"). As general licenses, the GTDA and GTDR are secured by satisfying regulatory conditions rather than by submitting an application to and issuance of an export license by DOC. This means an export can occur almost immediately rather than after weeks of waiting for an export license. For this reason, technical data being eligible for a general license has important business consequences. Foreign access to most commercial electronic databases is on the authority of the GTDA, which permits access from anywhere in the world, not just free world countries. There are no restrictions on the availability anywhere in the world for information which is covered by the GTDA. The GTDR is available for the export to the free world of most other technical data, even the most sensitive manufacturing know-how. Written assurances against reexports of such technical data and its direct product to Eastern Bloc and other prohibited nations must be secured prior to export under the GTDR for the most sensitive technical data.

International Traffic in Arms Regulations(2)

ITAR governs the export of commodities and technical data related to munitions, military equipment and other military and defense commodities on the Munitions List. The regulations do not explain the Munitions List in any detail. For the most part, however, the commodities and technical data covered under ITAR are mutually exclusive from those covered under the EAR but customized commercial items supplied under a defense contract may be covered. For example, ITAR rather than EAR may be applicable when a U.S. contractor provides technical specifications to a foreign supplier pursuant to a defense contract. A frequently encountered overlapping area with the EAR is software which includes a file encryption capability. ITAR governs in this situation.

The general rule is that a license must be issued by the Office of Munitions Control for the export of both classified and unclassified technical data unless the data is in the public domain or an exemption is available.

"Technical data" is defined as:

(1) Classified information relating to defense articles and defense services;

(2) Information covered by an invention secrecy order;

(3) Information which is directly related to the design, engineering, development, production, processing, manufacture, use, operation, overhaul, repair, maintenance, modification, or reconstruction of defense articles. This includes, for example, information in the form of blueprints, drawings, photographs, plans, instructions, computer software and documentation. This also applies to information which advances the state of the art of articles on the Munitions List but does not include information concerning general scientific, mathematical or engineering principles.

"Public domain" is defined to include information which is published and which is generally accessible or available to the public:

(1) Through sales at newsstands and bookstores;

(2) Through subscriptions which are available without restriction to any individual who desires to obtain or purchase the published information; or

(3) At libraries open to the public.

The definition of "export" includes oral, visual or documentary disclosure of such technical data to foreign nationals in connection with visits by U.S. persons to foreign countries or to foreign diplomatic missions and consular offices, visits by foreign persons to the U.S. or otherwise. A license is required regardless of the manner in which the technical data is transmitted (e.g., in person, by telephone, correspondence, electronic means, telex, etc.).

There are no general licenses equivalent to the GTDA or GTDR available under ITAR. There are only limited exemptions from the licensing requirements which are applicable only to exports to free world countries, and there are fewer exemptions for classified technical data than unclassified data.

DEPARTMENT OF DEFENSE POSITION

The U.S. government has traditionally restricted the release of information that could harm national security on the basis of a classification system. The DOD is the dominant force in establishing classifications and ITAR has been a major regulatory vehicle in controlling such technical data. In general, restrictions have focused on protecting information with military and nuclear applications produced by the government or with government funds. NSDD 145, described below, may result in significant restrictions on the free flow of traditional public domain information including that in electronic databases.

DOD's primary justification for the need for improved controls is the September, 1985, DOD report entitled "Soviet Acquisition of Militarily Significant Western Technology: An Update" which provides details on the Soviet program to acquire certain Western technologies. These technologies include "hardware, documents and know-how" and Soviet "targets include defense contractors, manufacturers, foreign trading firms, academic institutions, and electronic databases." Soviet scientists have reportedly confirmed that they regularly gain access to the databases to keep current on key technologies and to use software which may reside on such systems.

The electronic databases identified in the report are primarily unclassified, scientific and technical databases available from the government and the private sector. DOD wants some of this information to be protected as sensitive information even though it would not be within a national security classification. In addition, according to DOD, the compilation of unclassified information into a single database, which permits extensive manipulation and analysis, can lead to aggregated information which is sensitive. The report concludes: "In recent years, the growing use of electronic databases has provided the Soviets with an even more efficient means of identifying and procuring such unclassified technical information needed by Soviet designers."

National Security Decision Directive 145

DOD's recent public statements and the Air Force study mentioned below are based on National Security Decision Directive 145, signed into effect by President Reagan in September, 1984.

Under this directive, the security of both commercial and military information systems is the responsibility of the National Security Agency ("NSA"). National security was cited as the authority for the President to move responsibility for such security from DOC's National Bureau of Standards. NSA, in essence, has become an electronic security research and development arm and a security standards setter for the U.S. computer and information industries.

The stated objective of NSDD 145 is to ensure the security of telecommunications and computer systems that process classified and sensitive government information, to provide security assistance to the private sector and to promote the new standards in the private sector. A specific organization has been created within NSA to accomplish this including a 22-member National Telecommunications and Information Systems Security Committee (NTISSC) chaired by an assistant Secretary of Defense who is also director of NSA.

NSDD 145 specifies that "systems handling . . . sensitive, but unclassified, government or government-derived information, the loss of which could adversely affect the national security," will become subject to the security policies set by NTISSC. In "systems which handle sensitive, nongovernment information, the loss and exploitation of which could adversely affect national security," NTISSC is to develop policies "encouraging, advising, and, where appropriate, assisting the private sector in applying security measures."

The president's decision gave NSA the power to classify and thus control information located in the private sector, which, in NSA's opinion, may affect national security. The directive created a new category of controlled information referred to as "sensitive but unclassified government or government-derived information" whose loss could harm national security.

NSA and DOD assert that implementing the directive is needed to curb the flow of sensitive information -- including U.S. business and economic data -- from highly vulnerable U.S. computers to adversaries. The breadth of NSDD 145 has raised opposition on Capitol Hill. Some members of Congress question the wisdom of giving the DOD the latitude to decide what information is labeled "unclassified sensitive," because virtually any information system located in the civilian agencies or the private sector could fall under its domain. At one extreme DOD may propose that information about the operations of the U.S. economy and financial structure should be protected.

Cost should also be a significant private sector concern. DOD, in its approach to security, treats cost as a secondary factor in determining the extent of required protection. The National Bureau of Standards, on the other hand, emphasizes a risk-management approach that uses cost as a primary factor. Thus, there is a potential, if not a likelihood, for DOD to require excessive expenditures to protect unclassified information.

The Air Force Study

This classified study reportedly examined the degree to which U.S. commercial databases were being used by foreign customers and the implications for U.S. national security. The study team met with the Information Industry Association and a number of database providers and vendors.

The study, completed in mid 1986, under the direction of NTISSC, reportedly confirms foreign access to US databases as a significant national security concern. Another concern is that computers and communications capability permitting the aggregation and manipulation of such information increase its vulnerability. In addition, DOD is concerned that advanced software used to search even publicly available databases may "create" sensitive information.

The Washington Post Article

A recent Washington Post article "floated" DOD's position on NSA's plans to implement measures under NSDD 145.(3) This article repeats certain DOD concerns over foreign access to U.S. origin information. First is that unclassified technical data which could be detrimental to national security is available through electronic databases that can be accessed from anywhere in the world. Second is that foreign users, by having access to such databases using sophisticated software, may be able to obtain access to technology they would be denied under the EAR. Finally, the DOD is concerned that databases permit information to be searched, organized and aggregated in such a way that the results of the search could be classified information.

According to the article, DOD officials are considering a number of proposals for controlling foreign access to U.S. databases, including access controls for the new classification of "sensitive information." Special passwords could be required to access such information. A second is to require foreign users to obtain a validated export license before gaining access to certain databases. A third proposal is to require database vendors to install software routines that would monitor who requests particular types of information. DOD has acknowledged the technological difficulties of implementing any workable scheme.

DEPARTMENT OF COMMERCE PROPOSALS

On May 16, 1986, independent of the DOD actions, the DOC proposed changes to its technical data regulations in part 379 of the EAR to provide clarified guidelines for the use of the general license GTDA. The proposals are based on the recommendations of a working group of representatives of various federal agencies including DOD. As indicated, the GTDA is the export licensing authority for foreign access to most commercial electronic databases. The proposed regulations did not change the scope of the availability of general license GTDR or discuss the relationship between the two general licenses. Although these DOC proposals may be superseded by DOD action, they are indicative of the divergent but generally more practical views of DOC on this issue. As discussed below, the DOC proposals aroused opposition among certain industry groups but received widespread support in the academic community.

Overview

The current regulations specify three categories of technical data which are eligible for the GTDA: (1) data generally available to the public; (2) certain scientific or educational data "not directly and significantly related to design, production or utilization in industrial processes" and (3) information contained in patent applications. "Data generally available" includes publications available at "nominal cost." The "nominal cost" test often indicates general availability, but can be unduly restrictive. Determining what dollar amount constitutes "nominal" cost is also difficult, including for example, in the area of mass marketed microcomputer software. The limits of (2) above mean that the GTDA is not currently available for the most important proprietary information licensed under a trade secret license or research results or other information whose dissemination is restricted by contracts.

The May 16 proposals would redefine these categories into four categories:

(1) Technical data that are already publicly available or will be made publicly available by the export;

(2) Information arising during or resulting from fundamental research;

(3) Educational information; and

(4) Information in connection with certain patent applications.

Definition of Public Availability

The proposed regulations are intended to make it clear that data need not be available to every person on the street to qualify as publicly available but rather availability to a community of persons, such as those in a scientific or engineering discipline, is sufficient. Technical data are made public and so become "publicly available" when they are put into public domain(4) in any form, including:

(1) Publication in periodicals, books, or other print or electronic media available for general distribution to any member of the public, either free or at a price reflecting an intention that the information be widely available to the public or to a community of persons, such as those in a scientific or engineering discipline, interested in the subject matter.

(2) Being readily available at libraries open to the public or at university libraries; or

(3) Released at an open conference, meeting, seminar, trade show, or other open gathering.

Definition of Fundamental Research

Fundamental research is basic and applied research in science and engineering, the results of which are ordinarily published and shared broadly within the scientific community, in contrast with proprietary research and industrial development, the results of which are ordinarily restricted for proprietary or national security reasons. The proposed regulations focus on the degree of "control" on the dissemination of the data and the "entity" performing the research. If the research is conducted at a university and is neither contractually controlled nor classified, it would be fundamental research. In contrast, research that is conducted by a business entity would be considered proprietary and therefore not GTDA, unless the information may be freely disclosed. Although almost all such proprietary technical data may be exported to the free-world under general license GTDR, several industry groups and major corporations oppose this definition because the GTDA is easy to implement and administer. The current scope of the GTDA does not include industrial process proprietary data which is protected by nondisclosure agreements but the commenters would apparently like to have its scope expanded. The availability of the GTDR is limited to free-world countries and, as indicated above, may require written assurances to be obtained from the party to whom the technical data is released.

If research is funded by the federal government and specific national security controls are agreed on in the funding agreement to protect information resulting from the research, the GTDA would not be available. Examples of "specific national security controls" include requirements for prepublication review with right to withhold permission for publication; restrictions on prepublication dissemination of information to noncitizens or other categories of persons or restrictions on participation of noncitizens or other categories of persons in the research.

GTDA's Applicability to Microcomputer Software

The May 16 proposals requested comment on the availability of the GTDA for software. The implication may be that DOC is considering ruling that the GTDA should never be available for software.

Under the regulations governing the export of software, an individual validated license ("IVL") or, in some cases, a written assurance is required for export to any destination of software covered in the Commodity Control List in part 399.1 of the EAR ("CCL"), in Supplement No. 3 to part 379 of the EAR, or in Sections 379.4(c) or (d) (nuclear and aeronautics related software) of the EAR. Except for software on the CCL, such exports may be made to free world countries under the GTDR. The GTDR may be used for the export of any software not covered above to all destinations except for the embargoed countries.

The regulations can be and have been interpreted that the GTDA governs in the event of a conflict. In other words, technical data which is generally available should be exportable under the GTDA even if it is of a type which would otherwise be subject to more restrictive export controls. For example, SPICE software for designing ICs is available at no cost from the University of California-Berkeley but is also of a type categorized within ECCN 1355A which requires an individual validated license for all destinations. The GTDA should continue to be available in such an instance since this software is clearly publicly available.(5)

Under the GTDR, one of the regulatory conditions required for exporting some software to free world countries is obtaining certain written assurances against reexporting the software and its direct products to prohibited countries, essentially Eastern Bloc nations. These written assurances are required at each level of distribution down through and including the end user. Determining what software may be exported without written assurances and to all destinations is not an easy task and DOC is reluctant to give written interpretations.

Thus, the clear availability of the GTDA for most mass marketed software for all destinations throughout the world would be an important marketing benefit and would give comfort to vendors that they are not breaking the law. No written assurances would be required. Most mass marketed microcomputer software is copyrighted only so that the ideas and designs embodied in the software are available to purchasers of such products without restriction. This software is intended to be widely available to the public in most instances or to a community of persons in other instances. Several commenters on the proposed regulations, including the author, proposed that "publically available" be based on the price for microcomputer software. Thus, if the sale or license price in the ordinary course of business is under $1,000, for example, the GTDA should be available for the transaction.

Release of IVL Technical Data in the U.S.

At present most technical data may be transferred within a companies operating network or to a joint venture partner under the GTDA or GTDR. The proposed regulations provide that technical data otherwise exportable only under an IVL (such as software used to design ICs under ECCN 1355A) may be released under the GTDR to employees who are foreign persons by an employer who is a citizen or national of the United States, a firm organized under the laws of the United States, or a university, subject to the conditions below. These provisions could ease the exchange of research personnel between a U.S. company and certain of its foreign subsidiaries but trade groups are critical of them for not going far enough to ease communications among affiliated companies. In general, commenters stressed the importance of permitting unrestricted transfers of technical data within a businesses operating network. The proposed conditions are:

(1) The foreign person must be a bonafide and full-time regular employee, or appropriate action has been initiated under immigration law that is intended to result in the foreign person becoming a full time regular employee;

(2) The employee resides throughout the period of employment in the United States;

(3) The employee is not a national of an Eastern Bloc country, an embargoed country, Afghanistan or the People's Republic of China;

(4) The technical data are not listed in either Section 379.4(c) or (d) of the EAR (nuclear and aeronautics related data); and

(5) The employer has been assured by the employee in writing that the technical data will not be transferred to other foreign persons.

Database Controls

The DOC proposals would not require electronic database services to impose restrictions on access. Rather, a party producing information based on government funded research which might be included a database would have to determine whether a particular report could be made available. The funding agreement for government research is the point at which such controls would have to be imposed.

SUMMARY AND CONCLUSIONS

These developments raise the extremely important policy issue of freedom of information because foreign access to databases and other technical data cannot be controlled without also affecting access here in the U.S. The very nature of information makes it difficult to know when it has been transmitted to or acquired by someone else. For this reason, once information is disclosed here in the U.S. it is usually available to any party, domestic or foreign. Prior restraint on publication or availability is a consideration since the category of "sensitive information" will have a chilling effect on the free flow of information. "Sensitive information" cannot be categorically defined and no process can be established within DOD (or DOC or elsewhere) which provides U.S. business with interpretations quickly and inexpensively. Sensitive information can only likely be identified after one sees it, particularly when search commands organize and aggregate information which, when combined, becomes "sensitive."

Technical feasibility in requiring access controls and other precautions and cost are fundamental concerns. Policing such controls at each access point to an electronic database service to make them meaningful could require a customs officer type decision for every use at the terminal site. There is no present cost-effective way to meaningly limit access by passwords because of the vast number of terminals available to the public at libraries and elsewhere. Neither the subscription process nor password control offer a real solution. A recent article pointed out how easy it is for Eastern Bloc countries to have access to these databases because of branch offices and affiliates here in the U.S.(6)

It is more feasible to attempt to prevent information from being released at all for use in a database rather than to try to control the conduit through which information is made available. Information resulting from U.S. government funded research can be controlled by a provision in the research contract which restricts disclosure or publication. As indicated, however, a prohibition on including "sensitive" information in a database could result in there being little if anything included in the data base given the definition's potentially broad scope. The whole database would have to be classified.

There is a natural protection for the most sensitive information produced in the private sector. It will never be released except in an issued patent or under nondisclosure obligations because of its competitive value. Governmental regulation is not needed.

Although there has not yet been a specific proposal, it would be catastrophic if DOD, on the authority of NSDD 145, attempts to change the current general conditions for exporting computer software, one type of technical data. The U.S. has a lead in this industry segment and the software industry has already suffered damage from a DOC flip flop on export controls during 1985. The industry needs to concentrate on generating revenues and meeting foreign competition not fighting unilateral export controls which are not imposed on its international competitors.

The Information Industry Association has formed a national security committee to make recommendations to NSA and DOD on these matters.(7) With the input of this group and others, hopefully, further controls on the export of U.S. technical data will be rationally considered and decisions made with a realistic perspective. Unilateral action would provide an additional significant competitive advantage to our foreign competitors in the important information industry, one of our few growth industries. The national security benefits of any such controls must clearly outweigh the potentially devastating effect on U.S. trade and freedom of information.

November 24, 1986

FOOTNOTES:

1. 15 C.F.R. pts 368-399. The technical data regulations are in part 379.

2. 22 C.F.R. pts 121-130.

3. U.S. Seeking to Limit Access of Soviets to Computer Data, May 27, 1986, at A1.

4. One commenter recommended that the DOC clarify the proposal to ensure that information in a work protected only by copyright would be considered in the "public domain" for the purpose of the regulations.

5. Commercial products based on SPICE may not be exported under the GTDA.

6. Becker, West-East Data Transfer: The German Connection, Transnational Data and Comm. Rep., Aug. 1986, at 11.

7. The classification of "sensitive" information was created pursuant to NSDD 145 for the federal government's telecommunications and automated systems by an executive branch memorandum on October 29, 1986.

ALTERNATIVE TELECOMMUNICATIONS FINANCING IN DEVELOPING COUNTRIES

BACKGROUND PAPER

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Telecommunications investment is becoming increasingly limited due to the lack of economic growth in developing countries and the reluctance of foreign investors and creditors to increase their perceived risk in these countries. Nevertheless, the combination of specific institutional and financial factors which now prevail in certain countries can provide the framework and incentives for increased investment. One particular set of such conditions is described in this paper.

INTRODUCTION

Recent activities in several aspects of telecommunications development have lead to this summary of a specialized approach to selected country development projects. This approach, properly developed in the very near term, can provide a substantial benefit to all parties involved and, at the same time, act as an immediate focus for telecommunications activities which is consistent with the objectives for developing countries. A summary of the major points for consideration is presented below.

TRADITIONAL FINANCING

Traditionally, development of telecommunications projects -- especially in developing countries -- is undertaken as a government financed and owned project. These projects, and the imports required, generally receive multinational (e.g., World Bank) and commercial bank loans and supplier credits through the government for specific telecommunications projects. The multinational bank loans are generally of particular importance to the developing countries due to their loan provisions, which are, as the "lender of last resort", generally less restrictive than commercial loans.

However, even such favorable financing can contribute to a further strain on a country's finances, depending upon the specific status of currency reserves and the overall economic/financial status of the country.

Development with such conventional financing is also hindered in many countries as a result of low economic growth which, in turn, has recently raised the issues of a moratorium on loan payments, a time-phasing or reduction of principal and interest payments, or even total default on public and private institutional debt. The consequence of such potential actions has been to increase the perceived investment risk in these countries and to force lenders to reduce their exposure by refusing further loans and/or liquidating current creditor positions.

A FINANCIAL INCENTIVE ALTERNATIVE

Alternatively, privatizing the telecommunications infrastructure (operations and manufacturing) can provide separate investor incentives to foster development in these telecommunications areas. This can be accomplished without creating an additional financial strain on governmental financing and provides the framework for alternatives to the current approaches. Moreover, the unique circumstances of a debtor country orientation toward privatization, coupled with a lender tendency to liquidate or convert existing country debt, creates a unique investment opportunity for private investment, especially from developed countries to the telecommunications/electronic sector of a developing country.

Consummation of such a multifaceted arrangement can provide benefits to all parties involved. The essential components of such a mutually beneficial program include the following:

(1) a U.S. or foreign commercial bank has an outstanding loan to a developing country which it desires to liquidate (i.e., sell);

(2) a potential investor in the developing country purchases the loan from the bank at a discount (e.g., in dollars if a U.S. bank);

(3) the discounted note is repurchased from the investor by the developing country, at a premium in local currency;

(4) the investor uses these funds for initial or expanded investment in the developing country.

Clearly, the interrelationship and achievement of these factors is oversimplified here. However, at least three points should be evident from this development financing approach:

(1) the potential benefits to each party provide the incentives to complete such an agreement (i.e., the bank reduces its risk, the investor increases investment funds, and the country reduces its debt while increasing productive investment);

(2) several variations of the proposed approach are possible (e.g., direct debt to equity conversion with mutual lender and country approvals); and,

(3) the benefits of the approach presented can be magnified through various currency relationships (e.g., for a non-U.S. investor currency which is strong against a dollar denominated bank loan to a developing country) and other investor-country agreements or concessions.

CONCLUSION

Implementation of the basic approach described above should be investigated for three reasons: (1) it is timely with respect to the economics and investment opportunities in many developing countries, (2) it is consistent with the stated policies of industrialized countries for providing assistance to developing countries, and (3) it can provide near term favorable results to all parties concerned.

Education at Home Through Teleconferencing

by
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Abstract

Education at home can mean many things to many people. It can mean traveling a short distance from home to a local high school or shopping mall. It can mean taking class from your own living room, office or hospital bed. At Rio Salado Community College, education at home through teleconferencing means all of these things.

The College Without Walls

Rio Salado is a non-campus college, a college "without walls." Rio Salado was created in 1978 as the sixth college of the Maricopa County Community College District, the third largest community college district in the United States.

Rio Salado serves all of the 9,226 square miles of Maricopa County. The college's mission is to reach students who are not served by more traditional educational services, and one of the ways the college accomplishes this mission is through its department of Instructional Technology. The department of Instructional Technology is responsible for the delivery of credit courses through a variety of delivery systems, including print based, audio and video cassette, radio (broadcast and subcarrier), television (broadcast and cable) and teleconference (audio and slow scan video, which adds visuals and computer generated graphics to audio teleconference classes.)

Audio teleconference is the college's most recent delivery system, and it is this technology that enables people to access live, interactive credit classes from home or office, wherever their location, by simply using their telephone.

The SUNDIAL Network

The SUNDIAL Network, the college's audio teleconference system, began operation in 1983. The technical heart of the network is the Darome Meet-Me Bridge. The network is a non-dedicated system which gives it the flexibility to serve a more diverse population. Students and faculty interact over regular telephone lines, and any place can serve as a "classroom," as long as there is access to a telephone.

The network is staffed with a full-time bridge operator who monitors all activities and can directly interact with users on the system. Having a full-time bridge operator expands the versatility of the network and enables the system to respond to the demands of a classroom environment. Sound quality is constantly monitored and adjusted, classes can be separated into discussion groups and then reunited, the instructor can talk one-on-one with a student and then return to the group, and audio tapes can be played over the system when desired. Each class session is taped, and students can request copies of tapes for review. The system can link up to 20 sites, whether they are single call-in sites (home or office) or group sites.

In addition to its primary function as a credit course delivery system, the SUNDIAL Network is used for many local, state, national and international conferences, executive meetings, in-service training programs and other administrative activities.

How SUNDIAL Meets the User's Needs

Originally, SUNDIAL was established to link people isolated in rural areas of Maricopa County. Teleconference equipment (Darome conveners and microphones) was located in sites throughout the county, and students traveled to the closest site to take class. Group teleconference sites are still used and are located in shopping malls, on military bases, in businesses and industries, high schools and community meeting rooms countywide. Instructional Technology maintains no permanent sites, but rather determines site location based on user demand.

In 1984, Instructional Technology responded to user needs and expanded its services to include students who could not travel to a group site, even though those sites were located close to their home or office. These students include parents who care for small children, people caring for a spouse or aging parent, office workers and professional people whose schedules do not allow time for driving to a class site and the physically handicapped, those people who are at home, in the hospital or in care centers. Physically disabled people are especially well served by this system. For this group, the social, classroom environment of the teleconference network is invaluable. As one student stated: "I'm in life, even in the hospital."

The Fall 1986 investments class is an excellent example of the diversity of users getting an education from "home" via the SUNDIAL Network. There are three group sites which are all branch offices of the same company (two are located on opposite sides of the county and one is in the southern part of the state). Other group sites include an east and north valley high school, one of our sister community colleges and a west valley shopping center. The single site students include four physically disabled people, one parent caring for a handicapped child and a student whose work schedule does not permit the necessary travel time to get to a group site.

Students are constantly amazed and excited by the opportunity of taking live, interactive classes from home. They especially appreciate the ease of the system; all they have to do is dial a phone number. Our students who call in from home or office use speaker phones or just hold a regular handset. Some of our students prefer to use the headsets provided by the college. The headsets are lightweight and allow students to take class from almost any position while still having both hands free.

Classes vary in length from a one hour meeting three times weekly, to a once a week meeting for three hours. Participation is the key for successful interaction on the system, and all faculty are trained in maximizing the interactive potential of the network and in adapting their course materials to fit the teleconference delivery system.

Special Advantages

The obvious advantage to being a homebased student through audio teleconference, in comparison to other types of alternative educational delivery systems, is the spontaneous classroom atmosphere. Our students comment that it feels like a class: "There is a united feeling, a comradery of students through technology."

Another advantage of audio teleconference for students taking class from home or office is the access to expert resources. Both students and faculty are impressed with the flexibility of the system in "bringing in" guest speakers. Bob Robson, the current issues instructor, has brought in guest speakers such as Ted Koppel of ABC Nightline, Arizona Senator Dennis DeConcinni, and Arizona Congressman John McCain. A student who has taken class over the system from home for the past two years feels strongly about such opportunities: "How else would I be able to speak on a personal basis with such people?"

Many of our faculty are adjunct faculty, experts in their fields and managing careers outside of their college teaching. SUNDIAL gives these instructors the opportunity teach from home, office, airports or hotels, anywhere their business takes them. Ed Hammond, who teaches management in addition to managing his own consulting firm, frequently calls in from out of state. For Spring 1987, Mr. Hammond may even be calling in to class in mid-flight.

In addition to being able to cost effectively tap into people who are experts in their fields, the SUNDIAL Network's dial access capability allows students to access outside resources necessary to complete class assignments. Students in the American Folk Music class were able to call in individually at their convenience and listen to music tapes. Through SUNDIAL, the class also was part of the "live audience" at a folk music concert at a Phoenix restaurant.

Support Systems

For all students who take class through Instructional Technology, the user support system is course operations, a staff of three who provide support in terms of registration, course materials and messaging services to about 1300 students and 26 faculty a semester. Students can register and order their books by phone. They can speak with their instructors by phone every week during office hours, and there is a twenty-four hour student hotline number.

Instructional Technology is expanding its student support services through a computer based voice messaging system to be piloted in Spring 1987. The system will enable students to call in at anytime, access messages from course operations or from their instructors, and respond to them.

Activities Outside the Classroom

Every weekend the network is open for the Student Union. Students call in during the afternoons to form study groups, discuss class work or just visit. This fall the Faculty Lounge will come on line, giving the faculty the opportunity to gather together on a regular basis.

Through SUNDIAL students have also attended luncheons, conferences and participated in community functions. Students have been guest speakers and panelists at conferences on homebased education. They have spoken at Rio Salado's 1986 graduation ceremonies, and they have become participating members of the county's task force on homebased employment.

As We See It

Teleconference has proven itself an excellent tool in addressing the special needs of Rio Salado Community College's homebased students. The SUNDIAL Network is a cost effective method of bringing education to those people who are in remote, isolated areas and to those people for whom travel outside their home or hospital is impossible. The interactive nature of teleconference makes it an especially advantageous educational tool, as it preserves and intensifies the free flowing exchange of ideas which is a vital component of any educational setting.

For more information on education at home through teleconferencing contact:

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Wednesday, January 21

Morning Plenary

Rural, Remote & Small Users

"INTELSAT: The Pacific and Communications Development"

Joseph N. Pelton, Director, INTELSAT Policy
INTELSAT

Notes

INTELSAT: THE PACIFIC AND COMMUNICATIONS DEVELOPMENT

Joseph N. Pelton
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1. Abstract

Traffic in the Pacific Ocean Region is expanding more rapidly on the INTELSAT system that in any other place in the world. In the Pacific Ocean Region, INTELSAT is also achieving a new "Synergy" that combines the service needs of small, medium and large users. INTELSAT, in particular, in recent years has achieved important new breakthroughs in the delivery of services to small and developing countries. Key offerings now include: VISTA, Super VISTA, Intermediate Data Rate (IDR) carriers, Low-cost TV Distribution, New Earth Station Standards, Domestic Lease or Sale of Transponders, the INTELSAT Assistance and Development Program (IADP), Bulk Purchase Earth Station Procurement, the INTELSAT Development Fund (IDF), and Project SHARE. It is believed that these new service offerings will stimulate important and substantive gains for small and developed countries, not only in terms of economic growth and development but also in other vital areas such as health, medical services, and education. This articles envisions the continuing expansion of the University of the South Pacific Network, the Sky Channel educational offering for Micronesia and suggests the establishment of a PACMEDSAT to offer critical medical services in the South Pacific Region.

2. INTRODUCTION

Satellites are key to communications in the Pacific, both for the Pacific Rim as well as for the Pacific Basin countries. Long term and effective satellite communications solutions are needed for the region. In particular, new and creative ways must be found to combine the diverse communications needs of both the most economically advanced countries in the region with those with developing economies. The reason why complementary solutions are needed includes the following factors:

a) the great distance to be traversed on virtually all Pacific Region paths, both domestically and internationally,
b) the need for network flexibility to interconnect communication pathways that range from thin, medium to heavy streams of traffic,
c) the special needs of the South Pacific Island countries, based upon climate, economic constraints, etc. that can only be effectively be met by satellite communications, combined with the equally special needs of larger transnational corporations located in Pacific Rim countries which need high speed digital business satellite networks,
d) the need to minimize the expense of communication services in the Pacific Ocean Region, while at the same time, ensuring high degrees of reliability and availability, particularly to meet the new ISDN and digital communications standards.

Responding to their needs can perhaps best be achieved through economies of scale. In short, only a consolidated satellite system like INTELSAT can cost effectively respond to all these needs of the Region.

Although fiber optics communications systems will certainly form a part of the future communications network of the Pacific Ocean Region, the above four factors indicate that satellite communications will continue to serve as the basic infrastructure for meeting the communications needs and overall interconnectivity needs of the region into the 21st Century. In the Pacific Ocean Region small nations and large have a common telecommunications destiny.

The trends showing satellite communications growth as a primary means of telecommunications throughout the entire region, can be shown through several charts. The growth of earth stations in the region (see Figure 1) shows continuing network extension. The growth of communications demand as shown in the growth of traffic and of communications pathways (see Figure 2,3, and 4) reflects the fact that the region is growing more rapidly than the rest of the world with traffic growth averaging 20% per annum, well ahead of the global average of about 11%. Growth of communications traffic in the Pacific Ocean Region is projected in Figure 5 to the year 2000. It is significant, that these projections not only show steady satellite growth but that traffic will convert from being largely analog traffic to become by the end of the century largely digital traffic, particularly utilizing the new technique which we refer to as Intermediate Data Rate service (see

FIGURE 1

EARTH STATION GROWTH IN THE PACIFIC

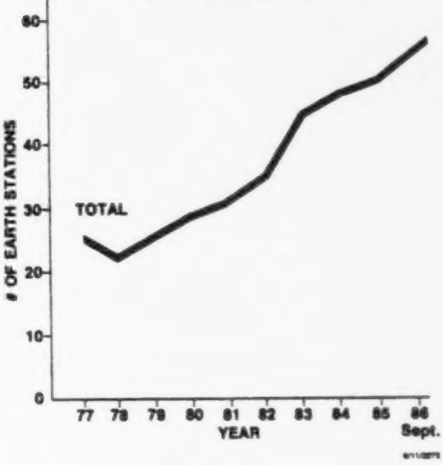

FIGURE 2

INTELSAT SATELLITE SYSTEM

Growth of Full-time Service

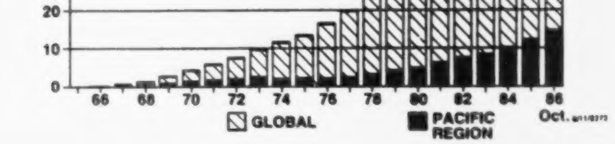

FIGURE 3

PACIFIC OCEAN REGION

Growth of Full-time Service

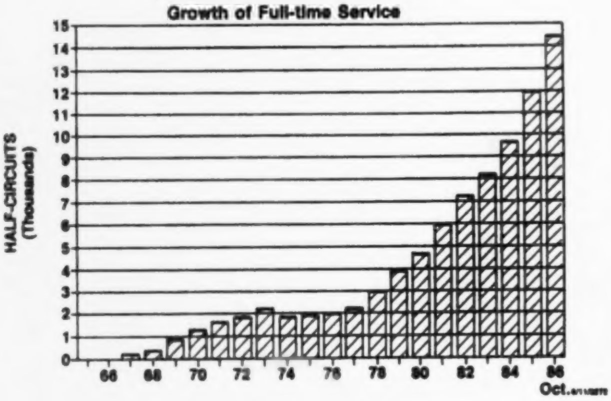

FIGURE 4

EARTH STATION-TO-EARTH STATION PATHS IN THE INTELSAT SYSTEM

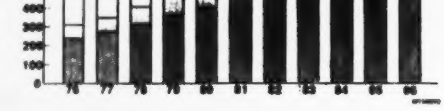

FIGURE 5

DIRECTOR GENERAL'S TRAFFIC PROJECTION

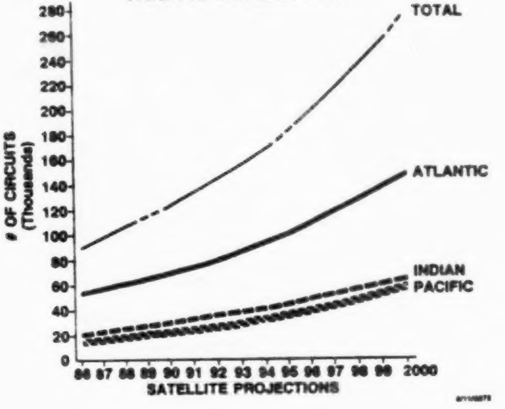

FIGURE 7

KEY INTELSAT SERVICES FOR SMALL & DEVELOPING COUNTRIES

- VISTA
- Super VISTA
- Intermediate Data Rate (IDR) carriers
- Low-cost TV Distribution
- New Earth Station Standards
- Domestic Lease or Sale of Transponders (1/4 on up)
- INTELSAT Assistance and Development Program (IADP)
- Bulk Purchase Earth Station Procurement
- INTELSAT Development Fund (IDF)
- Project SHARE

FIGURE 6

TRAFFIC DISTRIBUTION IN IS SYSTEM ASSUMING RAPID CONVERSION TO DIGITAL SERVICE (1986 - 2000)

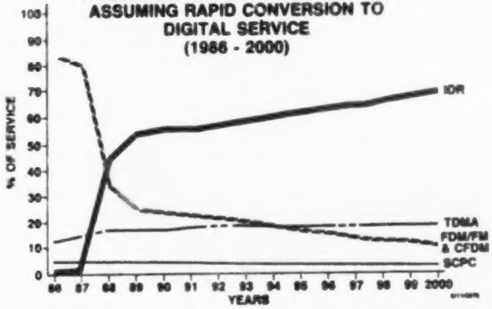

FIGURE 8

OTHER INTELSAT SERVICES WHICH CAN BE EFFECTIVE FOR SOME SMALL COUNTRIES

- INTELNET I and INTELNET II
- INTELSAT Business Service (IBS)

Figure 6). In our recent studies of digital tariffs it was assumed that there would be a rapid response to the financial incentives to convert the digital techniques. This projection as shown in Figure 6 forecasts a system that is over 85% digital by the year 2000. Two-thirds of the total will be IDR traffic.

What is particularly attractive about the so called Intermediate Data Rate (IDR) service is that it is extremely well suited to the small and medium user within the INTELSAT system. It is possible for instance, for an earth station owner to equip for an IDR carrier carrying 3 Mbit of traffic for a total cost of about $15,000. This IDR 3 Mbps digital carrier can carry the equivalent of about 48 voice channels using 64 kbit/s voice channels or ultimately up to 192 voice channels using 16 kbit/s voice. Furthermore, using digital speech interpolation an additional capacity gain of up to 2½ times can be achieved. Thus traffic volumes of up to 480 voice channels can be derived from such a basic 3 Mbit/s data stream using IDR service. Furthermore, this IDR carrier can meet ISDN digital standards of greater than 99.5% system availability and bit error rates of better than a 10 .

Thus, as can be seen in Figure 5, INTELSAT anticipates a strong and healthy growth of satellite communications in the Pacific Ocean Region over the next fifteen years. Along with this growth will be a rapid conversion between now and the year 2000 from analog to digital systems, particularly IDR networks. The more specialized INTELSAT Business Service (IBS) type of network will also experience rapid growth in the region both in developed and developing countries.

In the last 3 years, INTELSAT has made a significant move in the direction of encouraging the operation of smaller earth stations within the INTELSAT network. In particular, the 30 meter Standard A earth station has been downsized to a 15 to 18 meter dish. A large number of new standards has been added for new specialized services particularly for the INTELNET and INTELSAT Business Services. Most recently, INTELSAT has extended the public switched services to use not only Standard A and Standard B earth stations but now the smaller standards of E-2, E-3, F-2 and F-3 as well. It is anticipated that the INTELSAT Board of Governors will approve soon the use of antennas as small as 5 to 8 meters in size for public switched service utilizing Intermediate Data Rate transmission. This means that international gateways into the global satellite system can be constructed for a few hundreds of thousands of dollars as opposed to the millions of dollars that this would have cost several years ago. This type of network flexibility is of general utility to small, medium and large users. Dramatic shifts in the network architecture of the INTELSAT system are happening quickly. There is also rapid innovation in INTELSAT service offerings with some 350 new services have been added in the last three years. Awareness of these and other changes is important to understanding the new INTELSAT. This revitalized system can and does respond to all classes of system users, be they small, medium or large.

The INTELSAT system within the Pacific Ocean Region provides service to countries as diverse as China with a population of approximately of 1.2 billion people, and Tuvalu with a population of 7,000. The diversity of INTELSAT service offerings must be not only broad but also flexible. We call this flexible response to diverse service needs, Synergy. We feel this Synergy is critical to the future.

In spite the challenges of providing service to such a diversity of countries it has nevertheless been possible for INTELSAT to provide a broad range of services targeted primarily to small countries. To illustrate how INTELSAT develops services and implements them for some of the smaller countries within the vast Pacific Ocean Region of the world, several examples of services and their implementation by users have been chosen.

3. VISTA AND SUPER VISTA IN THE SOUTH PACIFIC

In December 1983, INTELSAT approved a new service known as VISTA for thin-route communications. One of the key features of this service was the fact that it could provide domestic service as well as form a network to link "common users" within a region. The "model" for VISTA, of course, was the South Pacific Island countries who need to reach their remote populations as well as talk to each other. This service essentially allowed similar economies to those achieved with domestic transponder leases to be made available to countries who had much more modest requirements. The VISTA tariff in effect, allowed telephone service to be derived on a circuit by circuit basis. The charge for this service, for the INTELSAT space segment only, was $525 a month per telephone channel on a fully protected non-preemptible basis, or $265 a month for a partially protected, and thus potentially preemptible, basis.

This service offering also envisioned the use of a new lower cost 4.5 meter antenna. This new earth station standard is specified with a lower off-axis emission standard and a relaxed polarization purity standard than had been conventionally used in INTELSAT earth stations in the past.

As innovative as this service offering was, the experience over the last three years has indicated that for the smallest and least prosperous countries VISTA was still too expensive. The cost of the space segment still appeared to be too high and the cost of the earth stations was also greater than the countries were willing to pay.

INTELSAT accordingly has moved to introduce two further innovations to make INTELSAT service offering more responsive to the user community. In particular, INTELSAT has now approved a new service offering known as Super VISTA which allows for the introduction of demand assignment units in a VISTA network. This allows significant new efficies combining the gains achieved with demand assignment techniques with the advantages of time zone shift within a larger region. Super VISTA is thus charged at a rate that is three times less. The INTELSAT space segment tariff is only $95 per derived telephone channel per month for non-fully protected service.

The second innovation is the decision by the INTELSAT to serve as a purchasing agent for a large volume of VISTA earth terminals that could be purchased on a volume discount basis from a single supplier. INTELSAT, in this process, received bids from 10 of the world's most qualified and well known earth station suppliers. After evaluating the proposals in terms of technical quality, cost and delivery schedule, a contract award was made in November 1986. A detailed price matrix allows INTELSAT Signatories and users the flexibility to order one of two basic VISTA terminal sizes, namely a 4.5 meter 22.7 dB/K antenna or a 5.5 meter 24.5 dB/K antenna. Each terminal can be purchased with a wide range of options starting with a single voice channel with minimal redundancy up to 24 channel stations with complete redundancy, a power generator, etc. The cost of the basic 1 channel unit with the 4.5 meter earth station is $54,000 US dollars. Typically, equipped stations with several channels and some redundancy will cost closer to $100K. Although cost of these terminals are still more expensive than INTELSAT would hope, this represents a significant economy of at least 30%. The previous cost of earth station equipment were typically well above $100,000 US.

Associated with this discount agreement is also the availability of financing arranged through the INTELSAT Development Fund. Further the selected supplier, a U.S. firm, has also arranged financing through the U.S. Exim Bank. It now appears that there is significant interest in implementing a VISTA network in a number of countries in the South Pacific as well as creating domestic networks in countries such as Fiji, the Solomon Islands, etc. It is hoped that quick implementation will now proceed with operation of a new VISTA network in the South Pacific being achieved in 1988.

Over 20 INTELSAT Signatories have indicated interest in purchase of more than 150 of these new low-cost VISTA terminals. Several countries in the South Pacific are among those who have expressed their interest in purchase of earth stations. Further, INTELSAT, under the INTELSAT Assistance and Development Program, has agreed to help in the design of a Super VISTA network for the South Pacific if this is desired.

4. PROJECT SHARE

Another service offering which INTELSAT has developed over the last two years which has proved highly successful in responding to the needs of smaller users in the Pacific Ocean Region is known as Project SHARE. SHARE is an acronym that stands for Satellites for Health and Rural Education. Under this program INTELSAT makes available free satellite time for health and education related projects in rural and remote areas. This project is carried out on a cooperative with the International Institute for Communications which is headquartered in London and also involves an International Advisory Committee IAC) composed of 20 internationally known experts in health, education and communications. The Chairman of the IAC is Dr. Jim Stevenson, the Education Secretary of the British Broadcasting Corporation.

The first significant project under Project SHARE was that by the People's Republic of China, where a television transponder was made available for a period of 8 months to establish a National TV University. In the initial program, some 34 hours of programming were produced each week by Central China Television and the Ministry of Education and distributed to a network of 47 earth stations that was subsequently increased to 53 earth stations. After the completion of the educational demonstrations the Chinese government purchased 2 transponders from INTELSAT and began installing a large number of TV receive-only terminals. As of year-end 1986, a thousand of these receive-only terminals were in operation giving essentially a total national coverage for this educational network in which hundreds of thousands of students were actively participating. Ultimately, it is intended that, all ten million teachers in China should be able to be trained through the National TV University using satellite capacity. Obviously, this cannot be represented as a program regarding to the needs of smaller users of the INTELSAT System. The experience derived from this first large scale project under Project SHARE, however, can in several ways, be applied to the design of tele-education network of some very small scale users indeed.

In fact, Project SHARE has a tremendous potential for meeting the social needs of the smaller nations of the Pacific. Today, educational and health related telecommunications services are among the most critical of the Pacific Region. Approximately, 10% of all calls in remote island communities and rural areas of even larger countries are for emergency assistance, health or related purposes. This rate is more than 50 times higher than in countries with developed economies. Further experience with the University of the South Pacific using the ATS-1 satellite has shown that students can effectively take telecourses with a high level of completion with final test courses comparable to campus based students in Fiji. The cost of such telecourses, however, have been demonstrated to be four times less than conventional teaching.

Starting in September 1986, the University of the South Pacific (USP) began distributing its courses throughout the region using the INTELSAT space segment with INTELSAT Signatories making available earth segment facilities. This Project SHARE network now includes, Fiji, Cook Islands, Kiribati, Nauru, Solomon Islands, Tonga, Western

Samoa and Vanuatu. Other sites at Niue and Tuvalu may be added if VISTA terminals are installed in these remote islands.

Based upon experience derived from the use of the ATS-1 and ATS-3 satellites, USP courses are provided through two voice channels utilizing data transfer, audio conferencing and slow scan TV exchanges. Despite the fact that a number of elaborate and expensive satellites based solutions have been evaluated concerning an operational educational network for the South Pacific (some of which would have cost over $100 million) there is little doubt that lease (or perhaps even purchase of capacity) through the INTELSAT system is by far the most flexible and cost effective solution equivalent to about 1% of the expenses of the most expensive alternative.

Satellite educational systems for the Pacific Ocean Region are undoubtedly going to expand. The second system now scheduled for operation under Project SHARE is called Sky Channel. Under this project, funded by a U.S. NTIA grant, video programming will be distributed to Guam and throughout the Micronesian islands. This system, although much more expensive and ambitious than the USP network in terms of program production and satellite transmission, is still likely to be "cost effective" in providing up-to-date materials to a large and remotely distributed population. The University of Guam will be the primary production center for this new educational network.

The effective use of satellite communications for the social needs of small countries need not be restricted to just education. The use of the INTELSAT system to create a data based early storm warning system for the South Pacific has been seriously proposed and the telecommunications planning unit of the South Pacific Bureau for Economic Cooperation (SPEC) has began a serious study of such a system.

The great unmet need beyond such a storm warning system is a medical service and tele-health network for the South Pacific. The model now being used by Dr. Max House of the Memorial Hospital in Nova Scotia in another Project SHARE initiative to provide medical training and electronic diagnostic services to East Africa and the Caribbean Basin could be effectively used in the South Pacific as well. The initial implementation of such a system could be supported under Project SHARE. Establishment of a new PACMED satellite network for the South Pacific is perhaps one of the most significant results that could emerge from this PTC Conference. PACMED could be established at the same sites now in operation or planned for the USP and the Sky Channel networks. It could be saving lives before the end of 1987, at an expenditure level of only a few hundred thousand dollars. PACMEDSAT doesn't sound all that great and others can improve on its name, but the potential of this echo is enormous.

5. REGIONAL AND NATIONAL BROADCAST SERVICES

The demand for TV services are pervasive throughout the Pacific Ocean Region. Even in remote parts of Papua New Guinea, Indonesia or Peru, small receive-only TV terminals can now be found. Increasingly, fulltime satellite TV options are available to provide world news, sports and entertainment from national, regional and international sources. Already 12 fulltime international TV leases are available on a global basis and many of them are available to the Asia/Pacific Region. This means that competition to provide television throughout the Pacific Ocean Region will increase. Channel 7 and 9 of Australia, which are largely importing U.S. programming to Australia, are trying to expand their markets to the South Pacific. New Zealand is divising its own plan for TV distribution in the South Pacific Region based upon the use of an INTELSAT transponder. Depending upon the transponder and antenna beam utilized, effective distribution of TV can be accompanied in the South Pacific with relatively modest cost antennas 3 to 5 meters in size and ranging from $3,000 to $8,000 in cost. A full fledged TV distribution satellite system utilizing a 72 MHz INTELSAT transponder and a 1000 receiving terminal could be implemented at a cost under $10 million. Such a planned TV distribution system could provide not only entertainment, sports and news, but education, health services, storm warning and weather forecasts as well.

6. CONCLUSIONS

One could go on to give other examples, but it is hoped that the message is clear. The INTELSAT System does achieve what is sometimes called "synergy." We combine the needs of big, medium and little users of INTELSAT to produce a mix of services well suited to everyone. Figure 7 shows those services which INTELSAT now provides which are particularly well suited to the smaller system users. These include, VISTA, Super VISTA, Intermediate Data Rate (IDR) carriers, Low-cost TV Distribution, New Earth Station Standards, Domestic Lease or Sale of Transponders, the INTELSAT Assistance and Development Program (IADP), Bulk Purchase Earth Station Procurement, the INTELSAT Development Fund (IDF), and Project SHARE.

Perhaps even more important are two services appropriate to all users and which can maintain easy interconnection among different groups of users. The INTELSAT Business Services (IBS) and INTELNET I and II can be used equally effectively by both multinational corporations and say agricultural research centers in the South Pacific (see Figure 8). Very Small Aperture Terminals (VSATs) can be used with INTELNET I or II to support an offshore drilling rig operated by a large oil company or be used to distribute newspapers in rural areas through remote electronic publishing. Next May, INTELSAT will host a major Symposium and Exposition at our Headquarters on Small Earth Stations. It will not feature business applications, nor financial uses, nor remote area applications in developing countries. No, we will feature all these services and how they can work together to achieve "Synergy."

Although we are proud of recent progress with Project SHARE, the VISTA Volume Discount Purchase, the INTELSAT Development Fund and other development related services, we know there is still far to go. We invite your help in seeing that we ultimately achieve our goal--a Pacific where countries like Tuvalu, Niue and Nauru are as closely linked to their neighbours as Japan, Canada and the U.S. are electronically webbed together today. INTELSAT believes in such a dream. We believe it can come true before this century is complete. We invite you to help share the dream and to make it come true.

"Rural Telecommunications Requirements in the Philippines"

Rosauro V. Sibal, Commissioner
National Philippine Telecommunications Commission and
Director, Bureau of Telecommunications
Republic of the Philippines

Notes

RURAL TELECOMMUNICATIONS REQUIREMENTS IN THE PHILIPPINES

by: COL. ROSAURO V. SIBAL
Commissioner, National
Telecommunications Commission
Director, Bureau of Telecommunications

The quality and extent of telecommunication services in the Philippines are inadequate to serve the present needs of the whole country and to facilitate achievement of its economic and social development goals.

Within the context of the recent prioritization which the government has accorded telecommunications, it is the government's new policy that there be a national unified communications system capable of disseminating vital information, achieve mass education, and provide universal and affordable telecommunications services throughout the Philippines.

1. OVERVIEW ON THE PHILIPPINES

1.1 GEOGRAPHY

The Philippines, aptly described as the 'Pearl of the Orient Seas', is an archipelago of 7,100 island. It occupies a total land area of 300,720 sq. km. and a total coastline of 17,461 kms. It has a population of 56.7 Million people of which around 70 per cent reside in the rural areas.

The Philippines has a generally mild tropical climate characterized by relatively high temperature, high humidity and abundant rainfall. It has a mean annual temperature of 80°F.

The geographic features of the country consisting of 3 major island groups, namely: Luzon (141,395 sq. km.); the second, Mindanao; and the third, the Visayas and more than 7,000 smaller islands comprising 74 provinces create special communication problems.

1.2 THE PHILIPPINE POLITICAL SYSTEM

The Philippine political system is a hierarchy of geographic subdivisions. On top are REGIONS which are conglomerates of PROVINCES. At present, there are 13 regions covering 74 provinces with Metro Manila considered as a region with a single province. The provinces are further subdivided into MUNICIPALITIES of which there are 1559. Within a municipality are the smallest political sub-division-the BARANGAYS or BARRIOS. There are approximately 43,000 barangays in the Country with population commonly ranging from 600 to 6000 people.

1.3 THE NATIONAL ECONOMY

The Philippine economy has grown rapidly and continuously for the past three and a half decades. The Philippines has attained middle-income status and the average personal income per household in 1980 already exceeded P24,000 per year or over P2,000 (approximately $100) per month. In reality, of course, incomes in the Philippines are unequally distributed, such that about 70 per cent of the households earn less than the average.

The degree of inequality has been high for some time and there is yet no indication of any tendency to decline. While the average income per family is already modestly high (estimated at P25,000 per year in 1981), the families who enjoy this level or higher probably amount to only about 30 per cent of all family.

1.4 COMMERCE AND INDUSTRY

About 50 per cent of the population depend on agriculture and forestry for their livelihood with about 15% employed in manufacturing industries. Agriculture and forestry production accounts for 52 per cent of the Philippine visible exports while mining accounted for 16 per cent and manufactured goods, 25 per cent. Tourism is of growing importance and had triggered the construction of new hotels and resort areas. Tourism receipts have reached some 10% of commodity exports.

While much of the manufacturing is centered in and around Manila, the potential for development exists throughout the country because its abundant natural and human resources are widely distributed.

1.5 THE NEED FOR GOOD TELECOMMUNICATION

The wide dispersion of the Philippines traditional export items together with the need for its political regions to develop its indigenous commerce, agriculture, industry, human and natural resources point out the need for countrywide communications.

Also, the Philippines is still substantially (81 per cent) dependent on imported oil supplies. Hence, the efficient and economical use of transportation and its coordination is of major importance. Given the geographic features of the country, this can be substantially facilitated by providing adequate countrywide telecommunications services.

2. PRESENT STATUS OF TELECOMMUNICATIONS FACILITIES IN THE PHILIPPINES

The quality and extent of telecommunications services in the Philippines are inadequate to serve the present needs of the whole country and to facilitate achievement of its economic and social development goals. The spread and coverage of the existing networks are insufficient to meet even the minimal communication needs of the economy and society.

2.1 GENERAL

Telecommunications facilities in the Philippines are multi-owned as a result of the government's policy to allow the operation and development of telecommunications systems within the context of free enterprise. The telecommunication sector is highly segmented and fragmented by service, by technology, and by geography. The government acts as the regulating body and its efforts are at present directed towards the interconnection of facilities to effect a homogenous network.

The International Gateway is Metro Manila. International voice facilities are operated by the Philippine Long Distance Telephone Company (PLDT) while international record services are provided by Eastern Telecommunications Philippines, Inc. (ETPI), Globe-Mackay Cable and Radio Corporation (GMCR), Philippine Global Communications, Inc. (PHILCOM) and Capitol Wireless (CAPWIRE). The Philippines uses submarine, satellite and radio for its international terminal and transit traffic.

2.2 RURAL NETWORKS

There are currently 5 commercial backbone operators in the country whose facilities serve various communications requirements of rural areas. The long line systems of these operators utilize various types and capacity of equipment. The general situation, however, is that equipment capacity is proportionately dependent on the size and state of development of the community served. The service carried by this long lines facilities include voice, television, telegram, program transmission, telex, leased lines and special data services. An alternative system for serving rural areas use a combination of satellite and terrestrial facilities.

The domestic satellite (DOMSAT) system, which uses PALAPA (Indonesia Satellite) presently serves 12 cities and is carried from the earth station to different terminal points by PLDT. Other carriers avail of DOMSAT services through the above mentioned terrestrial facilities. Voice grade channels are available on a free-assigned single channel per carrier basis (SCPC) with provision for Demand Assignment Multiple Access (DAMA) features. Real time television are also provided thru the DOMSAT system.

2 3 TELEPHONE NETWORKS

a LOCAL EXCHANGE NETWORK

As of December 30, 1985, there were 869,845 telephone stations in service in the country of which approximately 77 per cent are located in Metro Manila. The remaining 23 per cent is distributed over the country covering the major cities and municipalities. The service coverage represents only about 16 per cent of the total land area of the country. There is an unbalanced concentration of telephone facilities in Metro Manila and indicates the pressing need for rural telephone expansion.

The 52 local telephone service operators in our country serves about 265 cities and municipalities with 216 telephone exchanges. The present telephone density throughout the country is 1.6 while in Metro Manila the telephone density is 9 for every 100.

Twenty-five of the 226 local telephone exchanges in the country are still manual; about 73 exchanges are Step-by-Step Strowger switches; while the rest use a wide variety of Crossbar switches. PLDT operates some 20 electronic switches. Of the exchanges, 73 per cent are in Luzon, 19 per cent in the Visayas and 8 per cent in Mindanao.

The annual telephone density growth rate ranges from 5 to 12 per cent.

b. TOLL

The privately-owned Philippine Long Distance Telephone Company (PLDT) and the government-owned Bureau of Telecommunications (BUTEL) presently provide long distance service with the former carrying about 90 per cent of total telephone traffic. There are about 72,420 domestic toll circuits serving different routes in the country.

The total telephone requirements of small independent telephone companies are served through interconnection with the backbone system of PLDT with the latter providing the interconnecting facilities. The system of Butel serves only the exchanges operated by the government telephone system. Other government-owned telephone systems (not of BUTEL) are interconnected with PLDT. For the interconnection of telephone systems where PLDT facilities are presently unavailable, PLDT leases voice circuits from the other domestic carriers, PT & T, RCPI, the Domestic Satellite System and Butel.

The present domestic long distance network serves about 157 cities and municipalities and reaches out to 249 inter-island points where no local telephone exchange presently exists. Toll stations are established in selected areas to enable the public to make long distance calls to any point in the country and the world.

The present long distance traffic is handled on an operator-assisted basis and in some points there are already Domestic Distance Dialing (DDD).

2.4 DOMESTIC TELEGRAPH, TELEX, AND DATA NETWORK

There are presently 2,113 telegraph stations in the country, 1,921 of which are located outside Metro Manila provided by 7 privately owned telegraph operators including that of the government operating entity, the Bureau of Telecommunications. The service coverage represents 84.6 per cent of the total land area of the country. Telegraph service serves 1,344 of the 1,559 total cities and municipalities in the country.

At present, the domestic telegraph network covers about all the towns and cities in the country. However, because of limited traffic, backbone circuits are time-shared and therefore, the 24-hour message delivery time is sometimes not met.

The telex data network is relatively efficient simply because subscribers are presently limited to major cities where they are readily available. Domestic telex subscribers presently numbers 2254.

2.5 TELEVISION PROGRAM TRANSMISSION

Only two carriers presently offer this service, namely: PLDT and DOMSAT. The service offered by the former is basically point-to-point because of limited of capacity of its present backbone system, while DOMSAT acting as a carrier's offers multipoint distribution service for television and program transmission.

2.6 RADIO AND TELEVISION

Radio has a special appeal to the rural areas as a source of public information and enjoyment. In the small barrios or barangays, the transistorized radio receiver is a most prized possession.

As of December 31, 1985, the NTC has authorized 407 radio stations, as follows: 300 AM stations, 73 FM stations; and a total of 34 television stations.

3. RURAL TELEPHONE PROGRAM

The Philippine telephone operating companies in support to the national government objectives of accelerating the economic, political and social development of the country had also launched its Rural Telecommunications Program. This was envisioned to enhance the country's economic growth particularly in the rural areas. At the lead of this program are the Philippine Long Distance Telephone Company (PLDT) and the Bureau of Telecommunications (BUTEL) which presently account for almost 90% of the total local telephones in the country.

To encourage the dispersal of industries to other areas outside the National Capital Region (Metro Manila), it was envisioned that fast and reliable communication facilities between regional centers be established to reduce the congestion in highly urbanized areas.

3.1 THE PLDT X-4 PROGRAM

Under the PLDT X-4 Program, 281,000 telephones were to be installed. The program also called for the installation of 216,000 electronic switching lines and their corresponding outside plant cables all over the country. New links in their microwave backbone were completed which substantially expanded the toll message handling capabilities.

Complementing the expanded backbone was the installation of 8 digital toll switches which dramatically cut down on the time to process long distance calls by operators. PLDT's network had not only been enlarged by around three times but its use had also been made efficient with the digital exchanges. With these 8 digital networks established in Cagayan de Oro (Mindoro), Cebu, Iloilo (Visayas), Legaspi, Lucena, San Fernando, La Union, and Manila, the international gateway (Metro Manila), PLDT has laid the foundation for the integrated services digital network which will be able to handle a wide range of voice and non-voice services such as video, teletex and facsimile using a common digital exchange and transmission facility.

Although PLDT X-4 Program called for the installation of 216 000 lines by 1985, only 206,000 lines were completed of which 70% of these are already operational.

The Metro Manila exchanges were the first to be scheduled for expansion. 190,000 lines are distributed in various exchanges in Metro Manila of which 130,000 lines are now operational. The remaining 10,000 lines shall be of the digital type.

The installation of electronic facilities enables PLDT to introduce Direct Distance Dialing Service (DDD) and to host special services to its subscribers. With this service, a subscriber can dial direct telephone numbers eventually to 32 of the country's cities/municipalities and key places in 119 countries around the world.

Also part of the X-4 Program is the installation of cellular mobile telephones with access to international long distance service.

PLDT's data communications network or digital transmission facilities is also almost complete covering principal cities with the network allowing data transmission up to 9,600 bps.

Part of PLDT's X-4 Program is the rehabilitation of plant facilities central offices and outside plant cable network. While new electronics exchanges and cables were installed in Metro Manila, the remaining electro mechanical switches have to be reconditioned and the outside plant cables rehabilitated. The plant rehabilitation project was so extensive in nature that several central offices switching equipments were retired.

3.2 THE BUREAU OF TELECOMMUNICATIONS (BUTEL)-RURAL TELECOMMUNICATIONS PROGRAM

The Rural Telecommunications Project of Butel for Regions 1 & 2 is part of the Bureau's 10-year Development Program submitted to the National Economic Development Authority (NEDA). For this project, BUTEL requested in 1977 foreign assistance from Japan through the NEDA for a feasibility study on the project. The request was granted and the study was conducted by experts from the Japan International Cooperation Agency (JICA) in 1978. The Report showed the feasibility of the project and had recommended implementation in 2 Phases to suit funding limitations.

The Project envisioned to provide new switching radio multiplex trunk cables and telegraph on both regions. The network would provide direct distance dialing capability within the said toll charging and billing to be on a centralized automatic message accounting basis.

Six (6) combined toll and local switching centers and 11 local exchanges were to be set up and a total number of 11,124 telephone lines were to be installed.

It would establish a microwave backbone of 960 channel-capacity with spur links utilizing the SHF and UHF systems. It also provides for the setting up of one automatic telegraphy exchange of 120 lines with connections to 22 Gentex stations. The project includes a one year maintenance assistance and training in Japan and the Philippines.

The schedule of implementation of the Project was from 1983 to 1986. The project directly benefits 60 municipalities and approximately 2 Million of the 6.5 Million population from Regions I & II. Since the BUTEL network shall be interconnected to PLDT's nationwide network, the Regions will have access with the rest of the world. As of year ended June 1986, the project was 99.8% completed with full operation expected in October 1986.

4. PHILIPPINE CONSTRAINTS IN RURAL TELECOMMUNICATIONS DEVELOPMENT

While the PLDT's X-4 Program expansion and that of BUTEL's Regions I & II have to some extent expanded telephone coverage, the same does not account much in terms of meeting the telecommunications requirements of the country. The telecommunications industry is beset by a number of constraints.

4.1 FINANCIAL

The telecommunications industry is capital intensive in nature that revenues alone are not sufficient to finance meaningful expansion program. A telecommunications company has to program its expansion not only to satisfy the communications requirement but also ensure the viability of the projects as well as the company's financial capability.

a. PLDT'S EXPERIENCE

On the basis of PLDT's experience for its X-4 Program, the company suffered some delays due to several factors like local counterpart peso funds, the moratorium and devaluation.

PLDT's X-4 Program was supposed to start in 1977 or 1978 at a cost of $600 Million (about P5 Billion then) and the program was designed to be completed in four (4) years with a total of 216,000 lines installed or 50,000 lines per year. At the start of 1986, the company had already spent a total of about P14 Billion after completing 92% of the program.

The need for long term financial assistance with concessionary terms can not be over emphasized. PLDT has another Project, a 7-year (1987-1992) program of service improvement and expansion estimated to cost P7.59 Billion. With this amount only 10,000 lines per year is programmed for Metro Manila and provincial exchanges. The program which aims to install only 10,000 lines per year from 1987 to 1992 is based on the company's limited financial capability. Foreign creditors have indicated that the company must limit its expansion. PLDT's long term service improvement and expansion program will depend to a great extent on government support as well as continuing financial viability to be able to get more assistance from internal and external sources of funding.

b. BUTEL'S EXPERIENCE

On the other hand, on the basis of Butel's experience the Project was conceived in 1977 to provide the social benefit to the rural areas when the dollar to peso rate was $1.00 to P8.50. The Project, as a whole, was expected to be viable but because of the devaluation of the peso in 1984 to 1985, economic viability of Phase A has become doubtful.

The total estimated cost in peso of the project was originally conceived at P688.4 Million. At the present peso rate, the project cost is P1.3 Billion.

4.2 OPERATION

The operational efficiency of rural networks is determined largely by two basic factors; personnel and equipment. The problem insofar as equipment is concerned, appears to be the present utilization of different technologies, different maintenance philosophies and the use of equipment with regards to capability with other existing sytem. Small operators are also faced with the problem of unavailability of spare parts for equipment purchased. This is brought about by the limited market and the unwillingness of suppliers to maintain an adequate level of spare components.

The industry is to some extent also faced with the problem of inadequate manpower. The industry is of such nature that specialized technical training is required for its operations personnel.

4.3 ADMINISTRATION

The problem of the telecommunications industry in the area of administration includes quality of manpower, executive organization and span of control.

Because the operations of the industry involves technical as well as non-technical aspects, the task of choosing people is difficult.

The executive organization is related to the availability of qualified manpower. Operations and maintenance of telecommunications equipment require specialized technical training. The distribution of long lines and local exchange network brings about a problem of maintaining and effective monitoring and management, considering the span of control.

4.4 RATE AFFORDABILITY ASPECT

Public awareness to the importance of telecommunications is expected to increase the demand for telephone service in served areas and in areas where there is no telephone yet. It should, however, realize the fact that the income of a family in the rural area is hardly able to afford for a telephone service. telephone service.

5. THE PHILIPPINE MASTER PLAN FOR DEVELOPMENT

In a study in 1981, undertaken together with the ITU under the auspices of the United Nations Development Programme (UNDP), the groundwork for a Philippine Master Plan was laid.

The first phase of the program includes the installation of national long line transmission system traversing all the provinces nationwide. It will allow the provisioning of public toll stations and public call offices to meet national, social and political requirements. Cognizant of the development in telecommunications technology, the long line transmission system are to be equipped to handle other services, but gives special attention to data communications. All new carrier exchange, in both voice and record networks, are required to adopt the latest state of the art in digital technology.

Initially addressing the telephone system, the plan projects the satisfaction of 60% of the total demand before the end of this decade or 1990. Subsequently, it hopes to supply 100% of this demand by the end of the Century. The total demand under this Plan was projected to be 3.0 Million main telephone stations by 1990 and 5.5 Million by year 2000. The growth rates for regional projects range from 5% to 12.8% or an average of 10.7%. The total investment for the sector from 1980-1990 will be $3.1 Billion. If realized in 1990, it is expected that there would be a great change in the social and economic base in the country which would carry the momentum of rapid growth to year 2000.

CONCLUSION

The Philippines already has an aggressive and ambitious Telecommunications Master Plan. Given the financial resources, despite the complexity posed by the inherent geographic features of an island archipelago, the Plan can be achieved. In a country, however, affected by the scarcity of financial resources and the stringent effects of monetary devaluation, we can not fully implement the Plan of installing a national transmission system that shall traverse all the provinces nationwide in the short time frame envisioned without necessarily affecting or sacrificing other equally important infrastructures and projects. It may take some time before the telecommunications requirements of the country are met.

Nonetheless, recognizing the great social and political impact telecommunications has in contributing to the stabilization of the people's livelihood and to the correction of the disparity between the rural life and the city life, the responsibility of the Philippine government to provide rural telecommunications is enormous. Hopefully, the Philippine looks forward to a telecommunications infrastructure, universal and at affordable rates, which shall serve as a catalyst for productivity, economic recovery and a GREATER PHILIPPINES!

MABUHAY AND ALOHA!

"Emerging Pacific Island Service Requirements"

Robert M. Engelbardt, Vice President
Pacific Operations, Hawaiian Tel

Notes

EMERGING PACIFIC ISLAND SERVICE REQUIREMENTS

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Abstract

Geographic isolation, poor economies, difficult environmental conditions and government policies, impede telecommunications development in many Pacific islands. This paper, presented at a PTC-87 plenary session, explores the problems and possible solutions.

The immensity of the area encompassing the Pacific Islands is difficult to envision for those who have never travelled in this region of the world. Flying coast-to-coast from New York to California and then back again would require still another thousand miles to equal the 7,000 mile distance between French Polynesia and the Republic of Palau. From Midway Island in the Hawaiian chain south to Rapa in French Polynesia, the distance is over 4,000 miles.

Straddling the equator within this area are thousands of islands ranging in size from tiny atolls to the large high islands of Papua New Guinea, New Caledonia, Fiji and Hawaii. Although their actual land area is small, many individual Pacific island nations have boundaries stretching thousands of miles with economic claim to vast ocean areas.

Geographers have neatly partitioned the region into the three major zones of Polynesia, Micronesia and Melanesia. Within these island groups, however, there are substantial differences in levels of social, political and economic development.

Over 6 million people are distributed over one state, two territories and one commonwealth belonging to the United States; two French territories; one New Zealand possession and fifteen independent nations. The most recent countries to achieve independence are the Marshall Islands and the Federated States of Micronesia, which were part of the U. S. Trust Territories of the Pacific since 1947. Only the Republic of Palau remains tied to the U. S. pending resolution of a constitutional issue.

Excluding Papua New Guinea with over 700 different languages alone, the remaining Pacific islands comprise many cultures with dozens of additional languages. Lifestyles vary from living in Hawaii's plush high-rise condominiums to basic subsistence in thatched huts surrounded by swaying coconut palms on atolls only a few hundred feet wide.

The wealthier and more developed islands enjoy excellent transportation and telecommunications services along with adequate water and electric power which are essential to support their economies and higher living standards. Many of the newer nations, however, lack these basic services and their geographic characteristics result in major obstacles and high costs for their development.

Reliable basic telephone and Telex services are still scarce or non-existent in a number of the Pacific Islands. Only a few have progressed to the point where advanced telecommunications services, now available in developed countries, have been installed. The need to improve communications with remote islands, sometimes thousands of miles distant from the main population centers, is common in most of the countries.

For many Pacific islands, however, the problems of high cost combined with weak economies results in stagnation or, at best, slow improvement in telecommunications development. The situation is further compounded by the highly technical nature of the business requiring qualified specialists to handle the design, construction, maintenance and operation of the systems. This expertise must generally be imported.

Most of the telecommunications installations in the Pacific Islands are owned and operated by the respective governments. Some have established government-controlled corporations which enjoy some autonomy and are not required to transfer their telecommunications revenues to a general fund. Those operated as successful businesses can use their earnings to finance telecommunications expansion and modernization instead of competing with other government agencies for capital.

Most purely government-operated systems, however, suffer from the serious problems caused by politically motivated decision-making and dependence on monetary grants or aid from other countries for construction and management. Equally serious is the perception that telecommunications is a lucrative business which governments should operate primarily for the purpose of generating funds to subsidize other government functions.

Too often, government decision makers are enamored with "buzz-words." They tend to over-simplify solutions to their telecommunications problems by taking a piecemeal approach instead of adopting a systematic analysis and design process. The latest technological breakthroughs capturing the headlines may not necessarily be the most practical for their particular service requirements.

For example, when satellite technology was first introduced, many Pacific island governments viewed this as a panacea. Indeed, satellite systems certainly offer dramatic improvements over high-frequency radio for long distance communications. In many instances, however, because of poor transmission in the local network, the benefits could only be realized when users placed calls directly from earth station interface.

Then came "digital." Many government decision makers believed that replacing their old electromechanical units with modern digital electronic switches would eliminate local network deficiencies. They failed to realize that digital switches are far less tolerant to a poorly designed and maintained cable plant than their electromechanical counterparts and would often provide limited overall improvement.

It should not be difficult to appreciate the plight of the non-professional government administrators in such situations. Subjects such as cable pairs, splicing enclosures, drop wires, load coils and other such seemingly pedestrian items are not nearly as stimulating as transponders, central processors, optical fibers and now, the latest buzz-word, "cellular."

This is not to say that such modern technological advancements have no applications in the developing Pacific island telecommunications networks. On the contrary, they most certainly do, but not without incorporating them in an overall system design approach which also takes into account the social, political and environmental conditions, particularly in the smaller island communities.

Because of their locations, many Pacific islands must contend with potentially damaging natural conditions such as high humidity and temperatures, coral dust, and heavy salt content in the air, torrential rains and typhoon force winds which can increase construction and maintenance costs. Some islands are located far from major supply centers with infrequent air transportation for rapid parts replacement.

The need to import expatriate technical and managerial expertise for long term support results in the payment of additional compensation and benefits over normal salaries as incentives for relocation to isolated areas which often lack common amenities. While these costs are sometimes subsidized by the developed countries and various international organizations, there is no guarantee that such support will continue indefinitely. The local administrations are constantly faced with the likelihood of having to replace outside expertise with less qualified, inadequately-trained and poorly-motivated government employees.

Added to these challenges is the administration of rates and tariffs. Although the U. S. and several other countries are deregulating telecommunications services and diverging from having artificially high long distance revenues support local service, few of the island nations can deviate from this more traditional pricing structure. This is because the average income of the residential subscribers is generally very low and these non-commercial users cannot afford the fully-allocated cost of providing local telephone service.

High international rates, paid primarily by business and government users, generate a disproportionately large percentage of the operating revenues. Elevated installation charges and deposits also contribute to the cash flow while tending to discourage many residential subscribers who place few overseas calls anyway. These schemes, however, fail to result in a viable operation particularly when the government, which is often the largest user, fails to pay its own bills under the false assumption that it shouldn't be charged because it is the owner of the system.

Many government telecommunications operations are greatly overstaffed. Where the government is the major employer, the retention of unqualified and unmotivated workers becomes commonplace. The few employees who do manage to achieve often cannot be rewarded in accordance with their performance for fear of upsetting the general compensation policies applicable to all government departments.

The difficulty of providing high quality outer island communications with interconnection to the telephone network at affordable cost is another major challenge. Single channel, solar powered, high frequency radio sets operating in the simplex mode are generally the only practical equipment for most island nations which have populated areas beyond the range of VHF and microwave systems. Although charges for calls are levied in some instances, most of the systems are used for health, safety and welfare purposes and rarely generate fully supporting revenues.

The distance problem is exemplified in the Republic of Kiribati where the main government and population center on Tarawa is 2,000 miles from Christmas Island. This is a large atoll which has major potential for tourism, fishing industries and further expansion of satellite tracking facilities already established by the National Space Development Agency of Japan.

Small earth stations working with thin-route satellite systems will greatly improve service quality and reliability over HF radio, but their relatively higher cost will further compound the revenue support problem particularly when there are many small islands to be served.

Realizing that the provision of modern, reliable, affordable and universally available telecommunications services is beyond the ability of some governments, the newest buzz-word touted as the cure-all, is "privatization." While a private company may eliminate or reduce the problems caused by poor decision making, excessive staffing, lack of technical expertise and the other deficiencies of government operations, it must adhere to the basic principles of good business which dictates recovery of expenses and earning a return on investment.

For privatization to be successful, a company should be granted a long term franchise to provide both local and international services. It should not be burdened with high cost and non-revenue producing services such as outer island radios, airport communications and broadcasting stations which are often included in the overall responsibilities of government telecommunications organizations. Operation and maintenance of these services should be provided under separate government subsidized contracts.

High taxes on revenues and excessive import duties on supplies and materials, which are often imposed by governments to raise additional funds, should be waived--particularly during the construction of new facilities. Favorable treatment for direct government loans and loan guarantees may also be necessary to enable the private company to adequately expand and modernize the system.

Judicious selection of the company to acquire the telecommunications operation is one of the most critical requirements for effective privatization. Telephone operating companies with experience in both local and international telecommunications should be the prime candidates. While some organizations may attempt to qualify themselves by acclaiming their general telecommunications experience, they may be incapable of effectively managing an operating telephone company.

An example of this was in the Northern Mariana Islands where the government privatized telecommunications in the late 70's. The first company franchised to operate the system had extensive experience in U. S. military telecommunications but none in commercial telephone operations. While the company had good intentions, it failed to follow through on promised modernization and expansion plans for the deteriorating system.

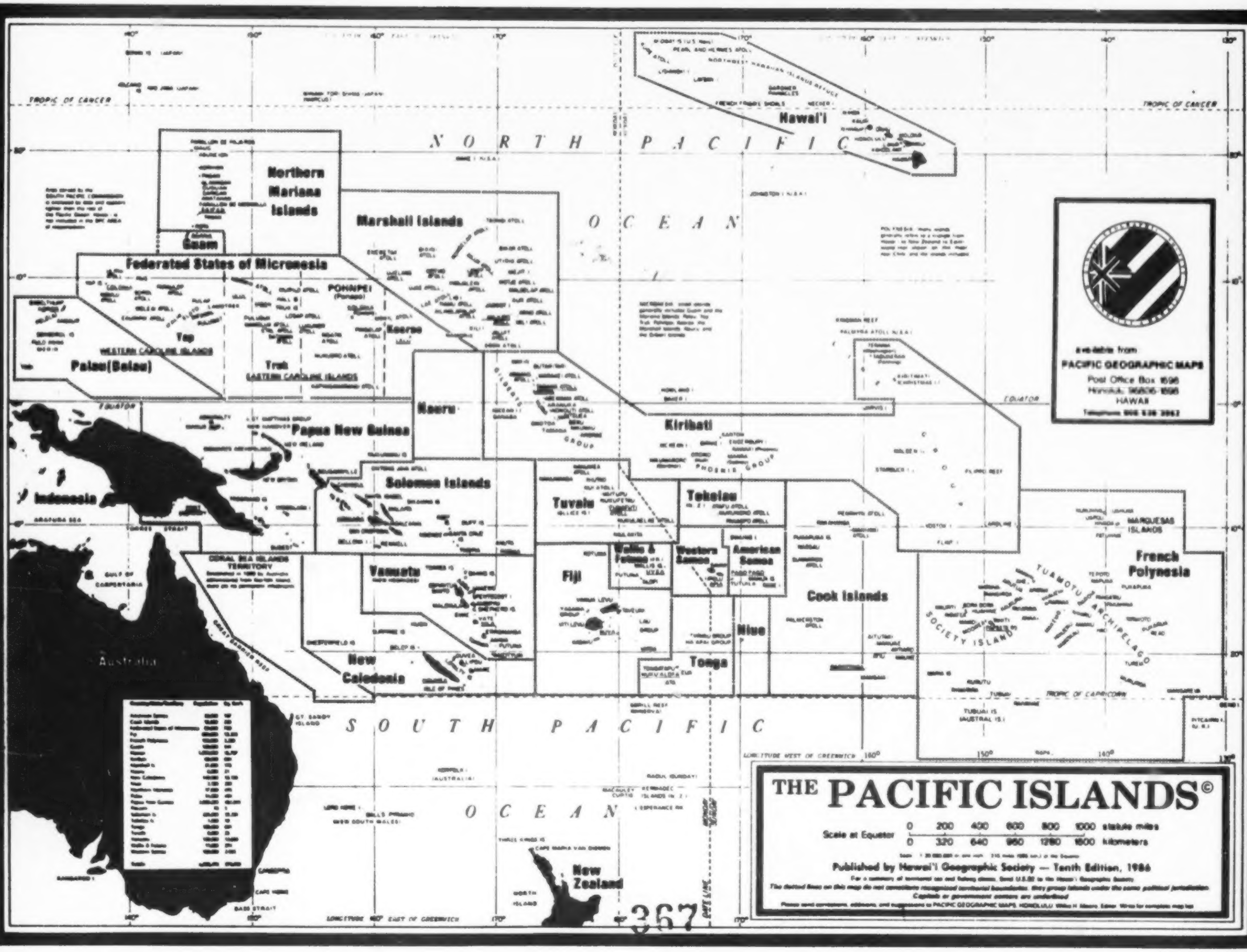
When Micronesian Telecommunications Corporation, a subsidiary of GTE Hawaiian Telephone subsequently purchased the company, it completely rebuilt the system under a government loan program administered by the U. S. Rural Electrification Administration. The fully protected digital switching system with underground cables and auxiliary power systems survived a major typhoon which struck Saipan on December 2, 1986 with winds up to 190 MPH. A structurally reinforced microwave system between Saipan and Guam remained operational and provided the only link to the outside world while the local network continued working normally during the crises.

While telecommunications privatization may be the ultimate answer for many Pacific islands, there are some success stories involving government operated systems. The proper combination of qualified personnel and management autonomy can result in the provision of service comparable to privatized operations.

An excellent example is American Samoa whose modern, reliable and profitable system was internally funded and provides excellent, universally available service. The system continues to be government-owned and operated by government employees. If privatization occurs here, it would be a result of government policy rather than technical or economic necessity.

For those Pacific islands less fortunate than the Marianas, Samoa and others which have good telecommunications systems, assistance is being provided by organizations such as the I.T.U., the South Pacific Bureau for Economic Cooperation and a number of private companies. PTC is also helping by bringing Pacific island telecommunications personnel to the annual conference in Honolulu. In addition, PTC has planned a special seminar to be held in a South Pacific location in the fall of 1987.

No single set of technical and organizational solutions can satisfy the diverse requirements of the Pacific Island communities. Continued sharing of information, expertise and advice through cooperation and open communications by the developed countries is the most effective way to address the many challenges and opportunities ahead. In this way, more of the islands can become self-sufficient in meeting their telecommunications needs.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CONCURRENT SESSIONS

SESSION 1
The New Environment

SOCIAL IMPACT OF INTELLIGENT TELECOMMUNICATION NETWORKS

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1. ABSTRACT

The Intelligent Telecommunication Networks are being gradually introduced to the business and private sectors of our society. This is evidenced by the proposed field trials by the various telephone operating companies in the United States during 1986 and 1987. This article summarizes the power and potential of the networks by depicting the novel features and services that it offers and discusses their social and personal implications. These implications for the users of the novel telecommunications facilities can be compared to the combined impact of the telephone services and the computer revolution. Easy world wide data base access, totally accurate and nearly instantaneous response at affordable prices brings home a new sense of power that the knowledge society has promised in the nineties. The misuse of such power in the social context is as probable as the misuse of the nuclear power in the political context. The social and personal damage which can result from such misuse can be devastating. This paper should be considered as the first step in the public discussion of an impact still to shock the society during the next decade.

2. INTRODUCTION

Intelligent networks have been evolving steadily for the last three decades. The primary entry of this type of a network in the public domain was the ALOHA network[1], even though the concept of adaptive intelligence has been inherent in the telephone networks. The more recent context of machine intelligence revolves around the digital processing of input data and adaptation of control data. To this extent, the introduction of electronic switching in the Electronic Switching Systems (ESS)[2] in the telephone central offices has been another landmark in the use of intelligence in the telecommunications industry. The explosive trend in the data processing field which indeed compliments the intelligent processing of the control data to channel the information in the telecommunication network catalyzes the power and the potential of the networks.

Knowing that these networks have been conceived in the laboratory environments, gone through their infancy in the telephone and packet switching networks, introduced in the business and computer facilities, these networks are now emerging in the public arena in the form of Personal Computer (PC) networks[3] and will continue to become mature as Integrated Services Digital Networks (ISDN)[4]. The regional telephone operating companies[5,6,7] in the United States have announced a series of customer services and field trials for the ISDN at customer bit rates 56 to 144 kilobits per second. More recently, the line rate is standardized at 160 kilobits/per second and the line code in standardized 2B 1Q code[8]. Also in this context, the telecommunication industry has standardized the bit rates of the various customer channels. The standard D channel is at 16 kilobits per second and remains open between the central office and the customer. The main use of this low rate channel is to provide basic line functions such as line scanning, telemetering, customer premises security, etc. The standard B or the switched channel is at 64 kilobits per second and provides a transparent data channel between any terminals equipped to handle the ISDN services. Here the 144 kilobits per second, customer rate offers the use of 2B channels plus 1D (2B+D) channel for communication.

The social and personal impact of these high speed networks has not been probed in any depth, even though the economic impact of these intelligent networks has been recognized throughout the world and is documented by the enormous amount of effort and resources dedicated toward establishing the interfaces for the local and the global exchange of information via these networks. The technical issues are being discussed in the T1D1 committees in America and in the CCITT[9] committees in the European continent. These technical considerations will be resolved given the economic incentives behind the commercial usage of these networks. The social and personal impact of these networks on people and resourceful corporations that will have access to the networks, will be the critical areas which will be discussed in this article.

Information networks are evolving rapidly and becoming digital. To meaningfully discuss their impact, we can classify these digital networks as local area networks (LAN), metropolitan area networks (MAN), national networks and global networks according to the physical limits of their access capability. The extent of intelligence incorporated in these networks depends upon the capabilities and a profile for optimally handling the basic communication functions. For example, in a national network where private data bases are embedded, the minimum extent of incorporated intelligence should be able to accomplish query handling from the users, evaluate the most logical data base to scan for the answer, address and dispatch the query, accomplish the path routing, perform the appropriate data base search, retrieve the answer, and do a retransmit of the answer back to the original user in a reasonable time and in an economic/optimal way without wasting the network resources. The adaptive intelligence can become an order of magnitude more complex than that in the local area networks where most of the basic functions are done by the terminals or computers that these LAN's interconnect. Most of the networks proposed now for metropolitan areas with national and international access have vast amounts of intelligence incorporated in them for speed, optimization, economy and security. Distributed processing concepts, algorithms[10] and general purpose digital signal processing (DSP) chips[11] all support the design and realization of these intelligent networks.

The progress of the industrial society towards becoming knowledge society is slow but steady. As more and more mechanical and industrial functions are being handled by intelligent digitally controlled systems (such as robots and numerically controlled machines), the network control of the sophisticated units becomes more and more imminent. Networks have the unique capacity to respond and communicate quickly, efficiently and optimally. Hence the concept of global control (via intelligent networks) in the context of an overall framework of universal knowledge in the form of data bases, is feasible. Such an environment fosters a new breed of (knowledge) worker in the (knowledge) society. It is here that intelligence and knowledge have to be merged together, for it appears that one is impotent without the other. Such a constraint demands that the worker who uses the knowledge be understanding of the framework in which that knowledge was generated. By the same token, the same constraint demands that the worker who generated that knowledge be understanding of the framework in which that knowledge is going to be used. Both these demands on the two groups of workers preclude the capacity to understand each others environments and this is not a trivial requirement. Two implications follow. First, both sets of workers need new and refined (knowledge) tools to work. Second, communication between these worker sets be optimal. These implications are investigated in the two following sections.

2.1 THE NEW KNOWLEDGE TOOLS

Knowledge has structure and language has grammar The expression of the knowledge is by the words of the language bound by the rules of the grammar. If one extended the idea of being grammatical about the structure of knowledge, then algorithms and optimization of conceptual relations form the words in the language of knowledge. It is our contention that functional modules that accomplish algorithmic steps in the processing of information and achieve optimization be considered as the tools of the knowledge worker. The classification of these tools should not be limited to the two types (algorithms and optimization) because the range of functions accomplished by such tools can be as varied as the range of words in a language. However, standardization of the algorithmic functions should be attempted as the standardization of the words in the dictionary of any language.

Algorithmic and functional tools can assume any form ranging from utility routines[12], microcoded control memories[13], integrated circuit chips[14], or even composite devices to digital signal processing units, micros, or even computational systems. Hence in the knowledge environment the functional tools at the disposal of the worker can be abstract and very tiny or be very large and physical.

2.2 THE NEW COMMUNICATION METHODOLOGIES

The features of digital communication make them optimal in most network environments. Even in the face to face human communication via networks, the trend is towards making all the transmission and recovery of information in the digital format by digitally encoded speech and video signals. The major steps of most of the networks in becoming totally digital have been documented[15]. The recent research is directed towards the choice of efficient code[8], error correction[16], fault tolerance[17] in the particular network environment. From an perspective point of view, this effort promises only a marginal gain due to the increased bandwidth of the newer media (especially the optic fiber and coaxial cables).

The second aspect of the communication between the workers deals with the human aspect. Audio visual communication has a proven edge over audio communication alone. The selection of the tools for the audio visual communication calls for newer algorithms[18], functions[19] and standards[20]. Progress is well under way to incorporate the graphic commands in most languages to facilitate the communications between workers via networks and intelligent graphic terminals[21]. Powerful graphics chips[22] are currently available from most major vendors.

3. IMPACT ON THE VARIOUS SECTORS

In this section, we narrow down the social impact of these intelligent networks as it is likely to appear in the public, the business/industrial, the educational, and the service sectors of the social environment.

3.1 PUBLIC SECTOR

The use of computer facilities in most government agencies is already evident in most of the countries. Automobile, tax, social security records, etc. are handled routinely by computer systems. Intelligent networks in association provide speed, accuracy, and efficiency of transmission together with the ease of global data base functions. Generally localization of information is typical with township and county governments and the impact of intelligent LAN's and MAN's can be significant. The impact of national and global networks is minimal in these situations, except when national records on key individuals, resources, taxes, sensitive information, etc. are to be remotely accessed. The documented effects of computerized access of data have prompted many of the municipalities, state and local governing bodies to have taken the first steps in acquiring and using low level stand alone micro's[23]. The full impact of networking is still to emerge.

Federal agencies operate under different conditions and constraints. The data bases may be widely dispersed, national security may be of concern, military data may be at stake, local and national emergency may exist, and so on. Networking has a profound effect upon the access of the relevant authoritative information. Intelligence embedded in networks offers speed, accuracy, confirmation, and optimality of the retrieved information at the *first* level. At the *second* level, the network or local computer can offer intelligent data base querying facilities. At the *third* level of intelligence, the network may provide "what if" facility available in some of the more refined Management Information Systems (MIS). At the *fourth* level a full fledged Decision Support System (DSS)[24] facility may be attempted. According to the currently available technology, the intelligent network may be designed to offer the capabilities of Artificial Intelligence (AI) functions[25] such as Pattern Recognition[26] (PR for automatic detection of imminent earthquakes, severe weather conditions, determining network information leaks, etc.), Expert Alert System[27] (EAS for checking and conferring with a group of experts, finding and tapping supporting the decision making evidence, etc.). The impact of intelligent networks is profound in these circumstances and there are definite areas of possible use and misuse.

3.2 BUSINESS AND INDUSTRIAL SECTOR

The monetary worth of the information and its timeliness play a significant role in this sector. Pertinent and timely knowledge has economic worth. At the corporate and organizational level, sensitive information can make or break major decision and the social impact of such actions of major companies is very significant in both a positive and a negative direction. For example, during the expansion phase of a business cycle, the size and location of a production plant influences the local economy and the jobs within a community. Accurate and sensitive information provided by an intelligent network, plays a role here. As another example during a crisis (such as the nerve gas leak from the Union Carbide plant in Bhopal, India or the nuclear reactor blowout in Chernobyl, Soviet Union) an intelligent network can automatically[27] or in conjunction with the user, perform many critical damage aversion and life saving functions. Quick and advisory information provided by an intelligent network plays a crucial role in this sector of the society.

In the industrial environment, the availability of technical information in the design support and production of the industrial product has a profound impact upon the corporate profits, survival and the social ramifications of major corporate decisions. Many high technology industries depend upon the high speed of access and accuracy of the algorithms used in the Very Large Scale Integration (VLSI) for integrated circuit chip design. Networking plays a dramatic role here. Intelligent LAN's are crucial in the manufacture of VLSI chips and in the production of automobiles in automated assembly lines. Intelligent MAN's and national networks[28] already support most of the major VLSI facilities and most of the personalized automobile production facilities. The social and personal impact of these networks is far reaching in these types of high technology industries as far as the new devices, and their subsequent impact (e.g. the influence of low bit "speak and spell" devices[29] marketed by Texas Instruments upon the education of non-native children). The environment is richer with both the primary and then the secondary impact of these networks.

3.3 EDUCATIONAL SECTOR

There is three-fold impact in this sector. *First*, universities are a fertile ground for new concepts. Some of the basic ideas for ALOHA network were developed at the University of Hawaii and the simulation programs in the 'C' language[30] at the University of California were coded for the two wire high speed data transmission systems of use in the ISDN, even though these simulation studies were performed initially[31] at AT&T Bell Laboratories at Whippany in New Jersey. *Second*, at the school level the networks perform very effective tools for computer assisted education and resource/data base sharing between schools. *Third*, the existence of terminals, nodes, and computer-network interface gear facilitates the young students to conceive and internalize the use and impact of the advanced technological (r)evolution of the nineteen eighties. The utilization of the intelligent systems and networks in the educational environment is perhaps the most effective method in preparing the young minds of any nation to cope with the transition towards the knowledge society.

The impact of networks on graduate research, library searches, faculty searches, administrative support, student records, etc. also exist and has already set in at schools and colleges around the world. This is likely to grow in the next decade. The existence of intelligence in the networks is not of great consequence since the current usage is routine and the role of the network is likely to continue in the service mode. The quality of current service is bound to improve and newer services can be easily appended.

3.4 SERVICE SECTOR

Routine services will become faster, more efficient and cheaper with the introduction of the networks. Innovative service will expand and multiply[32] Prevalent services such as telephone banking, facsimile, telex, etc. are prime examples of routine services. However, personalized news service, on-demand video sports facility, personalized tele-sales service, etc. are examples of newer services the intelligent networks promise to bring home to the customers. The technology to build such network exists and is being actively deployed for the Integrated Services Digital Network. The gradual and phased introduction of this network is well along the way in United States, Japan and Europe.

The services offered in our society are too numerous to list or to study the impact individually. Hence, we classify the services as being critical or non-critical services in our society, and indicate that the intelligent network will have a more profound impact upon the critical services. Network features quick access and intelligence offers accuracy and effectiveness for performing critical services. For example, medical services stand to derive an immense amount of benefit by finding the right procedures by being in contact with experts, by finding the quickest corrective measures, by maintenance on-line facility with blood banks, organ banks, sperm banks etc. National security services, federal bureau of investigation, immigration services, employment agencies, and most credit rating companies all have some network facility even though the extent of embedded intelligence may vary dramatically. As the data transmission rates and the intelligence are both enhanced the functions these service organization perform are also enhanced. The extent of the impact lies in the judicious choice of the alternative for expansion of the network capabilities.

Sales services also face a bright prospect with the introduction of intelligent networks. Data bases of customer preferences and matching of products offers higher sales potential. Machine/network assisted product and shop selection can spur a half motivated customer. Automated dialing can save the sales person time thus making more sales. The impact of such techniques upon the stimulation of economy is an area of future sales strategies.

Most service industries stand to gain three-fold from the phased introduction of the intelligent networks. *First*, the quality of service will improve in providing faster and more up to the second information. *Second*, the cost of providing such service is going to spiral down because of cost sharing of these networks. ***Third***, the range of services will enhance because of the national and global data base access that customer will scan for their needs. Travel, banking, hotel and resort industry are likely to be the immediate beneficiaries if they are not already receiving the rewards of the limited versions of the intelligent networks. In essence, immediate database access and improved service aspects are most likely to impact the critical services, whereas the improved services and reduced cost aspects are likely to impact the non critical service. Both these impacts are likely to be profound over the next two decades.

4. IMPACT ON PERSONAL LIFE

4.1 USE AND MISUSE IN PERSONAL LIFE

The newer services that intelligent networks bring about can be very beneficial. The right choice of a university for high school graduate, the appropriate medical center for a patient, network contact with educators, political leaders, etc. are examples which enhance the productivity of individuals. Preferential viewing can offer customer better choice of entertainment and an optimum use of leisure time. Stocks, bonds and other consumer items may be purchased automatically as the sales prices drop and billed to a customer account number with appropriate authorization. The stock market transaction may be made to follow the algorithmic preference of the participant and so on. However, there is one basic difference between the possible social and personal impact of these intelligent networks. When there is a broad region of possible social impact, it is very likely that the problem and its implication has been studied by a large number of people thus their collective wisdom has been instrumental in adopting the change. On the other hand, if there is an isolated region of personal impact, then the individual may choose to misuse the network and the impact may well become counter productive. Like every innovation, intelligent networks face the threat of misuse by individual in personal life, by organizations at corporate level, by societies at cultural level, and even by countries at a political level.

4.2 PYSCHOLOGICAL AND SOCIAL ISOLATION

Intelligent networks offer high quality, efficient service to an intelligent segment of the population. Networks response can be made to be deadly accurate whereas human response is initially inaccurate and needs iterative convergence for the interrogator to obtain the necessary information from another person. In the process of the interaction the two people learn more about the problem and about each other. This teaches one the ethics of the social environment in which one lives. Now consider the network environment. The ease, accuracy and extent of network response can be learned and mastered to a precise science. Intolerant as networks are to input error, accurate they are to human precision. Hence, it is our contention that if the intelligent sector of our population practices high efficiency in day to day functions, they will also be intolerant to human communication, thus building highly intelligent knowledge tools rather than social skills to get along with people and the human eccentricities. Common people in castles of knowledge with a mastery of network skills and a pair of high speed lines are manifestations of a sick society.

4.3 FAMILY STRUCTURE

Network assisted dating services can make instant couples around the nation and globe, thus changing the whole outlook on family life and altering the culture pattern of a society. Such changes can make the idea of a traditional family life obsolete for the intelligent sector endowed with the inherited or the acquired capabilities to use the network. The long range effect of a lack of family structure for this sector of population is its own extinction, if its intelligence is not geared towards its survival. Yet the long term survival of various species is based upon instinct rather than intelligence. Hence the underlying implication is the need for test tube babies incubated in highly controlled environments and automated training facilities. Without such facilities, we may only face a rapid decrease in the numbers of people who can use the network. Once again the users of the network are likely to have robotic and humanoid tendencies rather than having human and social skills. It is interesting to note that this inference is supported by the recognized tendency that isolated packets of cultures do not survive over a long period and we can ask the question whether intelligent networks catalyze the extinction of the intellectually elite or regroup them better for propagation and survival.

The personal impact over a couple of decades can be desirable, neutral or totally unwarranted. If the change is not managed by some sort of a ethical/legal framework, then the change that these networks bring about will influence the direction of the social change. And the direction of the prolonged change is likely to violate civil rights of some people causing social injustice to those who are poor in new tools (Sec. 2.1) and methodologies (Sec. 2.2) of the knowledge society.

4.4 CORPORATE INFLUENCE

Overindulgence in the economic activities by corporations is likely to offer new options and choices at a personal level. The use or misuse of these powerful networks is equally likely. For example the misuse of drugs and the abuse of the visual media in the propagation of pornography are two prevalent examples in societies. A less objectionable case occurs when children choose to spend an excessive proportion of their time with the television. Intelligent networks offer a higher quality and quantity of distractions at a personal level. For example, if all the sales information on high quality guns and ammunition is made available to a psychotic, an escaped convict, or a ring of arms boot leggers, the social cost would be enormous. The technological fact is that these networks can provide productive, counter productive and sometimes harmful information with equal ease, accessibility and accuracy. The usage intelligence is still in the mind of the users, though a legalistic framework can block the flow of information in certain undesirable directions.

With all the experience gained in the drug laws and surveillance, there is still a lack of control, let alone a prevention of the misuse of drugs and drug addiction in the United States! The problem does not stop here, the economics of drugs is radically different from the economics of information. Information may be true or false, information may be factual or misconstrued, information may be documentable or gossip, information may be objective or subjective and so on. Once broadcasted, the value of information is lost, and the public media can propagate information (true or false, factual or misconstrued, etc.), inexpensively. For this reason, the need for a social, cultural, ethical or a federal agency to monitor these networks is most urgent. Misused high speed networks with embedded super-artificial-intelligence face the threat of becoming well organized international mafia and espionage tools. Social intelligence atop intelligent networks can make or break the benefits that the society can receive.

5. MAJOR SOCIAL EFFECTS DUE TO THE TRENDS IN SERVICES AND COMMUNICATIONS

The divestiture of the Bell System under the consent decree of 1982 has had its impact upon the telephone bills, though not a desirable one. However, total deregulation of the telephone services is the next major step from judicial arm of the Government or the Federal Communications Commission. Some of the pathway has already been paved for the new vendors at the customer end. For instance, cable TV networks can offer enhanced features, privately owned local switches can provide low bit rate digitally encoded telephone communication, low speed video frame transmit capability can be offered over telephone lines, etc. When deregulation will have its full impact, the cost of such services is bound to decrease because the enhanced bandwidth for transmission is available (fibers and cable TV networks), switching costs are decreasing (larger number of vendors for small PBX's to major electronic switching systems), and network control is becoming cheaper (digital revolution and low cost VLSI).

Two consequences of direct social value are (a) reduced cost for a higher quality service like the price reduction of newer microcomputers, and (b) expanded bandwidth for communication. As we have discussed, both use and misuse of the networks due to (a) will ensue. As we discuss next, the consequence of (b) has a more serious ramification. If the embedded intelligence of the network is supplemented by the natural intelligence of the sophisticated user, the potential increases by an order of magnitude. The natural intelligence and the sophistication of use can be the privilege of a few. Since intelligent networks can only convey knowledge in the form of digitized information, they can only bring about an alienation between those who know and those who know not. They can also bring about isolation for those who wish to practice high efficiency with deadly accurate network commands thus leading to less tolerant society and perhaps more violence because of reduced interpersonal communications skills.

Organizations generally have more resources to tap the intelligence in networks than individuals. Knowledge is power and power can generate more corporate revenue thus fueling the spread of bureaucracy of corporations and weakening the ignorant. Since 70 percent of the world population is illiterate, there is reason to suspect that the gap will only widen. Next consider the remaining 30 percent, technical expertise and broad overall network understanding is possible only for a few; thus making them most solicited and highly paid corporate employees. The effect of this need is the creation of a packet of relatively few key people who may choose to misuse their knowledge skills and tools for large financial rewards or even for mischief as the superusers learn to find loop holes in the network intelligence. Recently there have been examples wherein bank employees have been able to gradually withdraw substantial sums of money for their personnel use by breaking into the networks as superusers of the system. As a next example, a group of very smart kids have been able to get at sensitive defense information.

On the positive side, the economic rewards are too numerous to list individually. In a broad sense, the increased speed, accuracy, and the global access at affordable costs can only enhance the individual and societal productivity dramatically. Exchange of data bases and knowledge tools between cooperating individuals and entities can spur the economy and bring about a better quality of life for most people. Travel, entertainment, leisure and communications industries will all be sizable beneficiaries of intelligent networks. Nations participating in the encouragement of these networks in the national environment can facilitate the growth of economy and education, thus accelerating the literacy and training the young minds to cope with and live well in an emerging environment.

Industrial society brought about Adam Smith to propagate Capitalism and Karl Marx to prevent the abuse the tools of Capitalism against labor. Information society needs a group of both intelligent and sensitive social scientists to manage the transition for the next two decades. The questions about intelligent networks is not if and when, but about their role, impact and possible regulation. The solutions to the problems need collective wisdom of scientists of various disciplines and political muscle that a progressive society can provide. The problems are too crucial for the decision to be sought be profit seeking network proponents and these are the same concerns that Karl Marx addressed about Capitalism. If the economics of material wealth has brought about the two competing idealogies (capitalism and socialism) in the world, we can only query the imaginative mind which idealogies the economics of knowledge can foster.

6. AUTHORS NOTE

In this paper, I do not want to portray intelligent networks as catalysts of dismay, doom and destruction of the society. The positive impact far outweighs the possible misuse and the by products of the networks. But I have addressed and focused the attention to some possible problems which may go unnoticed in our over enthusiasm for the major innovation to an already very intelligent society.

7. ACKNOWLEDGEMENTS

The numerous discussions with my colleagues and coworkers at the College of Staten Island and at Bell Communications Research are gratefully appreciated. Some of the possible secondary effects discussed in the paper are a direct result of group participation of this

rather important area of concern to everyone dealing with networks.

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DEVELOPING THE
TELECOMMUNICATIONS PROFESSION
Certification Program Design

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Abstract

Telecommunications is rapidly becoming an area of professional practice. Accordingly, standards and certification of competency are important issues for both educators and employers. This paper describes a professional certificate program and the underlying competency structure which can serve to guarantee the performance of telecommunications practitioners.

INTRODUCTION

The evolving technologies of telecommunications and the growing importance of information in individual and corporate life are creating needs for experienced, knowledgeable practitioners. However, most individuals now employed in telecommunications positions have, themselves, developed along with the industry. Consequently, they have little formal training in the subject matter of the field and their expertise is based largely on a combination of self-study and experience. As a result, there are no standards whereby professional practice can be judged nor are telecommunications workers able to find a means to organize their expertise.

The Professional Certificate in Telecommunications described in this paper gives form to this developing profession by defining the subject matter underlying practice. Representatives of telecommunications vendor and user organizations have participated in research studies to assist the authors in determining knowledge and competencies required for competent practice. These guidelines have been brought together in a certification program design which provides the delivery system and quality assurances needed to certify individual practitioner competency.

By making extensive use of telecommunications and computer technology, the Professional Certificate program makes it possible for individuals to build on their knowledge and experience. The combination of self-study materials, computer-based review and testing, and computer conferencing insures that each student's experience is tailored to his/her current level of knowledge and that each step toward certification is verified and documented.

DESIGN CONSIDERATIONS

The growing importance of telecommunications training is evidenced by the rapid increase of instructional offerings available to students. In a recent study conducted by DataPro Research Corporation the scope of telecommunications training was clearly demonstrated (DataPro, 1986). Of the 90 institutions responding to the survey, 14 offered two-year programs, 16 granted the baccalaureate degree, 13 the masters degree, and two offered a doctorate in telecommunications. In addition to these traditional programs, 27 survey respondents indicated availability of some form of telecommunications certification. Truly impressive growth over the 14 year period since the University of Colorado graduated its first student in 1972.

If the focus of attention is changed to the student, the above data take on new meaning. In market studies conducted by the authors, fully one-half of respondents now practicing in telecommunications have two years or less of college training. This means that there is a large segment of telecommunications manpower which is best served by certification programs. Since most of these individuals are full-time workers, they cannot be easily reached by traditional educational offerings. Instead, educational institutions must create new programs and delivery systems to reach out to the student.

The key concept in the above paragraph is that of a "new design" for certification programs. The requirements of this design are:

*Individual self-paced instruction.

*Reliable quality control and testing.

*Competency demonstration "on the job."

*Provision for updating content.

In addition, any certificate of value must be appropriately positioned as to telecommunications practice. That is, the knowledge and competencies of the certified individual must be at a sufficiently high level to render the certificate credible to employers and practitioners.

THE SUBJECT MATTER OF TELECOMMUNICATIONS

The first step in preparing a design for certification in telecommunications is to address the above positioning issue. Most certificate programs presently available are located at the lower end of professional practice (DataPro, 1986). This effectively eliminates the vast majority of currently-employed telecommunications practitioners who are in need of some endorsement of their professional skills. Therefore, the Professional Certificate design is directed at a level of knowledge and skill which is associated with masters degree level training.

The certificate resulting from this positioning decision is one which verifies that the holder is fully-qualified for significant job responsibilities in the field. Certificate holders should be able to take such positions as assistant managers in large corporations or account executives in vendor organizations. They are truly certified professionals rather than entry-level personnel.

Given this decision, the subject matter for the program is derived from a study of persons now holding similar jobs. Two interview panels were identified by the authors to insure coverage of both voice and data subject matters. These panels were first approached with standard glossaries of telecommunications terminology (Data Communications Glossary, 1985). Respondents were asked to indicate those terms which made up the essential knowledge base of a competent practitioner. This resulted in two lists of terms (representing voice and data content respectively) of approximately 60 items each.

The above lists were then used in a free-sort exercise whereby panel members were instructed to group terms which "belonged together." This procedure has been widely used to arrive at subject matter structure by other researchers and has proven to be an efficient way to poll expert opinion (Gorodetsky, 1985; Hambleton, 1977; Hartke, 1978). The results of these exercises were combined using cluster analysis to arrive at hierarchical orders of concepts in voice and data communications (Loesch, 1977). Figure I shows a typical output of the cluster program for a subset of data communications concepts.

FIGURE I

TYPICAL DATA COMMUNICATIONS
CONCEPT STRUCTURE

This figure shows how the OSI model organizes several communication protocols. It also illustrates the scope and sequence of concepts which students should master in order to be certified in this sub-field of data communications.

CERTIFICATION PROGRAM DESIGN

The over-all design of the Certificate program rests on three basic criteria. First, the program must assess entry readiness if it is to reach persons at the appropriate entry level. Second, the design should provide for a variety of pathways to the certificate in order to accommodate individual differences. Third, demonstration of competency should include both formal and on the job testing. These criteria lead to the process flowchart shown in Figure II.

FIGURE II

CERTIFICATE PROCESS

The choice of masters-level competency as the foundation for the Certificate produces the dual pathways pictured in Figure II. The left-hand side of the flowchart illustrates the steps involved in obtaining the Certificate for persons with field experience. The right-hand pathway accommodates persons with undergraduate training and minimal field experience. The important point is that entry to the program is controlled so that only individuals with demonstrated intellectual and/or field performance may qualify.

The validation step at the first juncture in the flowchart involves a thorough examination of candidate credentials. This includes

FIGURE I

TYPICAL DATA COMMUNICATIONS CONCEPT STRUCTURE

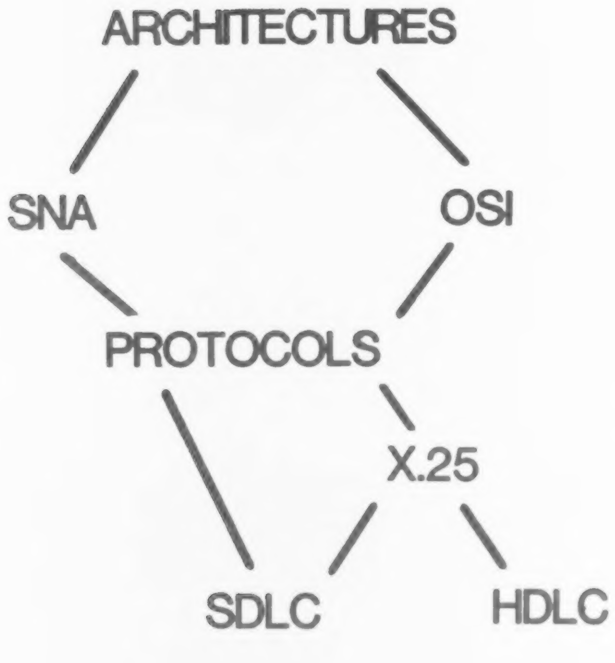
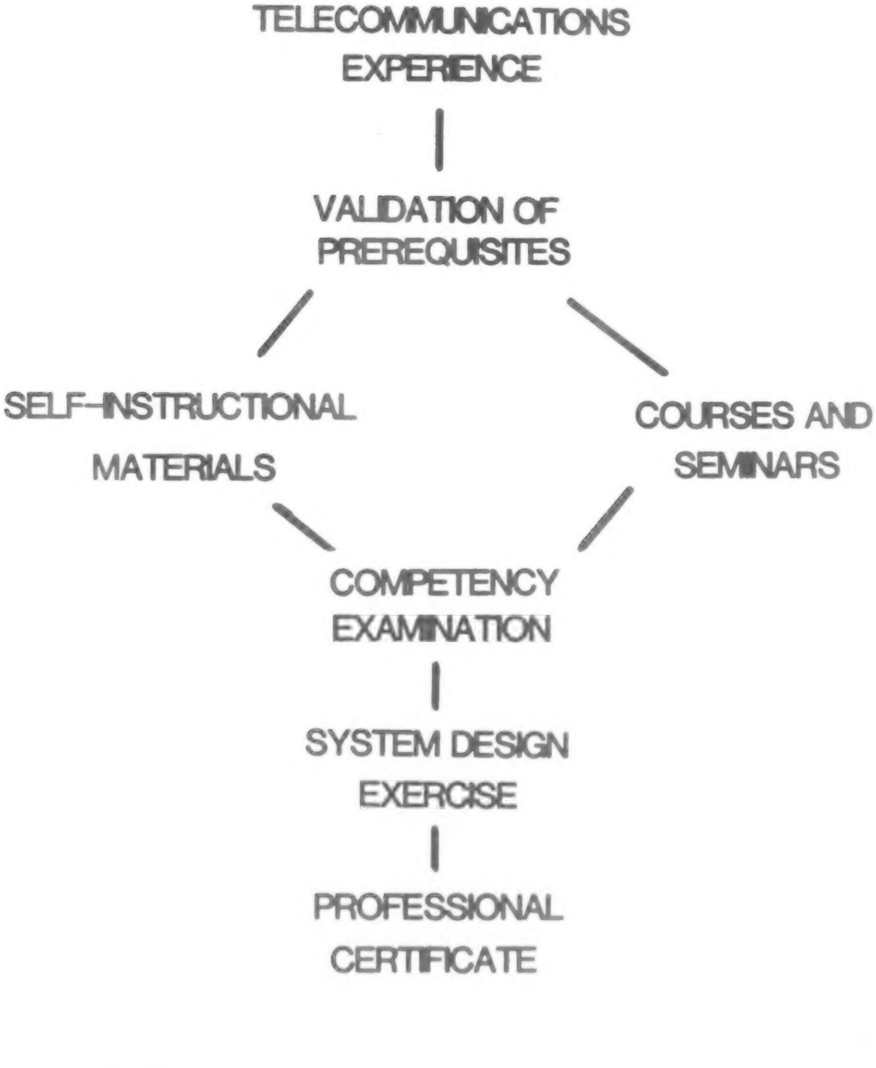

ARCHITECTURES
SNA
OSI
PROTOCOLS
X.25
SDLC
HDLC

FIGURE II

CERTIFICATE PROCESS


TELECOMMUNICATIONS EXPERIENCE
VALIDATION OF PREREQUISITES
SELF-INSTRUCTIONAL MATERIALS
COURSES AND SEMINARS
COMPETENCY EXAMINATION
SYSTEM DESIGN EXERCISE
PROFESSIONAL CERTIFICATE

assessment of academic records, employment history, and work products related to telecommunications application. Given successful demonstration of program readiness, students can proceed with either formal instruction or self-paced learning. In both cases, telecommunications content is managed by detailed study guides which are regularly revised to incorporate new ideas and practices.

The competency examination is a formal testing exercise in which the candidate demonstrates his/her ability to utilize telecommunications concepts. Since the Certificate is directed at professional practice, the examination is heavily biased toward resolution of typical telecommuniations problems. The competency base of the examination makes it possible to develop individual performance profiles for students which can be used to assist the candidate in utilizing his/her pattern of strengths and weaknesses.

The final step in the process involves identification and study of a telecommunications application problem. This study is carried out under the direction of a mentor who works closely with the student during the study. It is the task of the mentor to insure that the knowledge and skill of the student are in usable form. In effect, the mentor is a final quality control over the certifiable competencies of the candidate.

PACING INSTRUCTION AND TESTING

Accommodating individual differences in the program design is a difficult task at best. Rapid changes in telecommunications content makes it impractical to invest in sophisticated learning packages. For example, cost estimates on adding video support to a voice or data course is of the order of $75,000. This means that a more cost-effective approach is required.

In the PCT design, individual differences are addressed in content review and testing. Course content is divided into modules according to the subject matter structure described above. Each module is accompanied by computer-based review and testing software. With this design, new content can be added to any module without entailing whole-course rewrite.

The EMS-McGraw Hill Authoring System was selected for the program (EMS-McGraw Hill, 1985). This system allows for extensive text and graphics presentation with good program control over student progress. In addition, the software has testing and record-keeping features which allow performance monitoring of each individual student as well as instructional groupings. This makes the system ideal for competency testing in that each test item can be analyzed as to its discriminating power and its relationship to the total testing program.

THE INTERACTIVE DIMENSION

The independent study approach to telecommunications certification sets three major problems in instructional design. The rapidly-changing subject matter mentioned above makes it difficult to insure adequate coverage of key concepts and methods. Differences in individual progress rates and start times result in significant monitoring and quality assurance problems. The link between student and instructor is virtually eliminated and no basis exists for interactive teaching and learning.

In the PCT design, these issues have been addressed by studying the communications requirements posed by each problem. If we categorize these needs as to the number of participants and frequency of interaction, we arrive at a display of traditional media alternatives like that shown in Figure III (see also, Batchelder, 1985).

FIGURE III

COMMUNICATION PROBLEMS
AND INSTRUCTIONAL MEDIA

In this figure, problem (1) is that of modifying instructional content to insure currency. Problem (2) is that of program monitoring and quality assurance and (3) refers to student-teacher interaction. These three problems cover the whole range of size and frequency and have been addressed by a complex mix of traditional instructional media. Clearly, the solution to these problems must be flexible enough to accommodate student, faculty, and program demand on an "on call" basis.

The communication solution selected by the authors rests on computer conferencing software. The CoSy system, developed at the University of Guelph, provides a multifunction communication system which is readily adaptable to user requirements (Meers, 1985). CoSy, which is also the basis for the BYTE Magazine information exchange (BIX), has several features which make it an ideal medium for PCT participants. These are summarized in Figure IV.

FIGURE III
COMMUNICATION PROBLEMS
AND EDUCATIONAL MEDIA

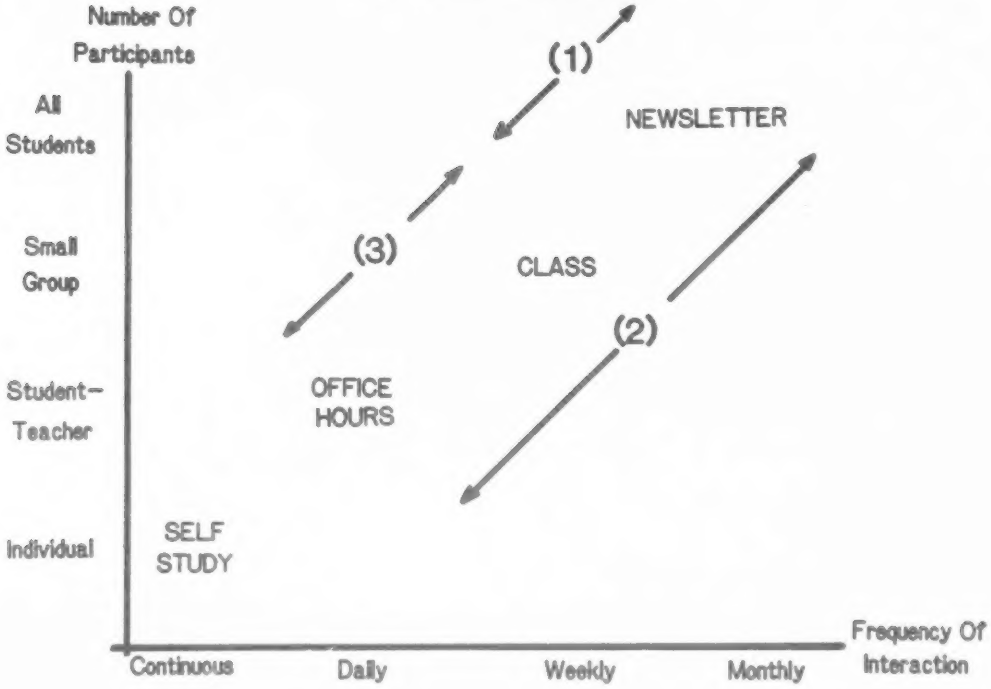
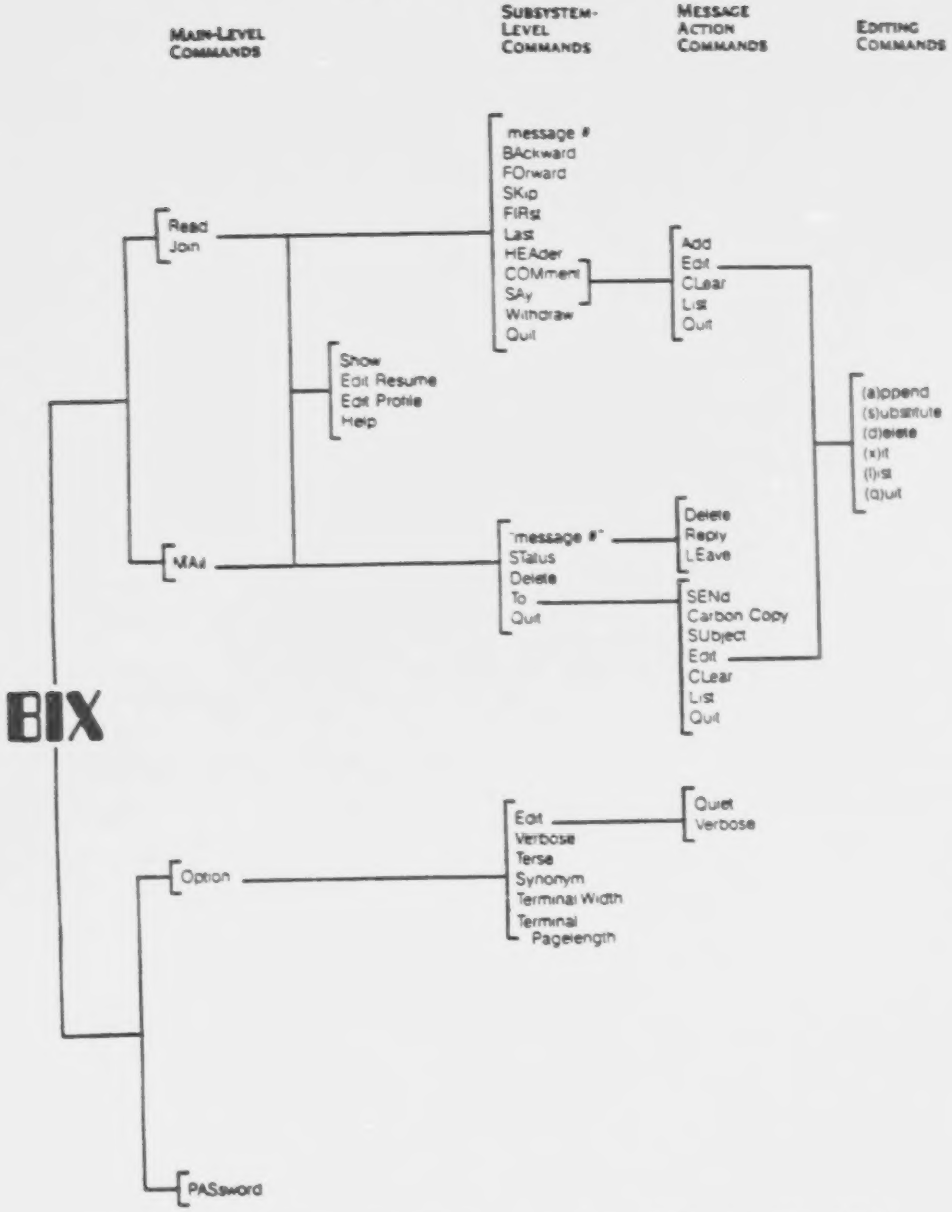

Number Of Participants
All Students
Small Group
Student-Teacher
Individual
(1)
NEWSLETTER
(3)
CLASS
(2)
OFFICE HOURS
SELF STUDY
Continuous
Daily
Weekly
Monthly
Frequency Of Interaction

FIGURE IV

COSY USER COMMAND STRUCTURE


MAIN-LEVEL COMMANDS
SUBSYSTEM-LEVEL COMMANDS
MESSAGE ACTION COMMANDS
EDITING COMMANDS
BIX
Read
Join
message #
BAckward
FOrward
SKip
FIRst
Last
HEAder
COMment
SAy
Withdraw
Quit
Add
Edit
CLear
List
Quit
Show
Edit Resume
Edit Profile
Help
(a)ppend
(s)ubstitute
(d)elete
(x)it
(l)ist
(q)uit
MAil
"message #"
STatus
Delete
To
Quit
Delete
Reply
LEave
SENd
Carbon Copy
SUbject
Edit
CLear
List
Quit
Option
Edit
Verbose
Terse
Synonym
Terminal Width
Terminal Pagelength
Quiet
Verbose
PASsword

CoSY user commands. BIX Manual, Mc Graw Hill, April, 1985

FIGURE IV

COSY USER
COMMAND STRUCTURE

In addition, CoSy has powerful conference organizing capabilities which allow faculty to structure student conferences on specific topics. Thus, new content can be readily transmitted to PCT candidates and individual student participation in discussing these concepts monitored by program faculty.

At the level of program management, CoSy provides for real time monitoring of student progress. Faculty can use student conference participation as a measure of readiness for testing and/or project initiation. During the course of student interaction with the local mentor, there is a constant two-way flow of information that directly addresses quality assurance issues. In effect, CoSy is the "glue" that ties the several components of the PCT into a working educational and certification system.

SUMMARY

At this writing, the above design is in Beta testing at Saint Marys College in Minneapolis, Minnesota. Test sites are also in place at several vendor corporations to determine the workability of individual progress features. Data on these tests will be available in mid 1987 as will summary program documentation.

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A new work environment applied advanced telecommunication facilities
-C&C Satellite Office-

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1. Abstract

As our society is rapidly changing from an industrial society in to an information society, where computers and communication(C&C) play an important role, NEC has proposed a Japanese style "work-at-home" environment, the "C&C SatelliteOffice", and has been carring out experiments on this concept for two years. This paper introduces the objectives of the Japanese style of"work-at-home", the C&C Satellite Office concept, the role of the telecommunication networks, the experiments concerning the C&C Satellite Office and the development of future applications ofsatellite offices.

2. Introduction

In the move from industrial society to information society, business activities have become more concentrated in the urban areas which are also the centers of government and economy. This greater concentration of population have been brought on by growth in business activities in addition to cultural and commercial activities which have attracted the young generation. The resulto f these social phenomenon has been to raise the price of the office space because of shortage of land, and force people to live far from the center of the city, and causing over-congestion of roads and railways. Thus, excessive concentration of business activities in urban area has made the working environments worse and commuting difficult.

On the other hand, the population in the rural areas is on the decrease and is changing in composition to a more olde rpopulation. The main industries in rural areas, tend to be agriculture and fishing, compared with high-technology related industries of urban areas. Thus, rural areas are experiencing less progress and the gap between rural and urban areas is expanding.

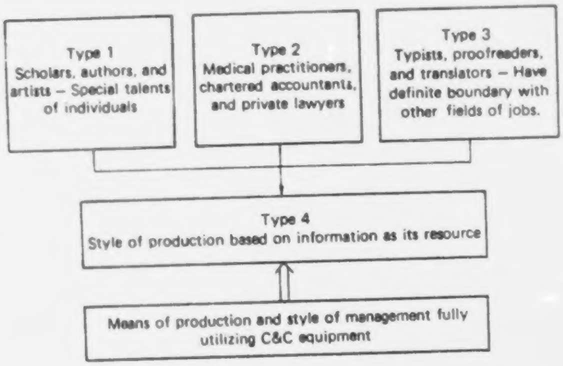

Type 1
Scholars, authors, and artists – Special talents of individuals
Type 2
Medical practitioners, chartered accountants, and private lawyers
Type 3
Typists, proofreaders, and translators – Have definite boundary with other fields of jobs.
Type 4
Style of production based on information as its resource
Means of production and style of management fully utilizing C&C equipment

Figure 1 PLACE OF WORK = PLACE OF LIVING "WORK-AT-HOME"

The development of employment opportunities for skilled persons who find it inconvenient to commute to urban centers, such assenior citizens, physical-handicapped people and women with families, is also becoming an important social issue.

Technically, the development of computers and communications is making information transfer and processing easy, and is helping to overcome problems of time and distance.

From this background, the new "work-at-home" concept is being developed in order to satisfy the needs of industries which require skilled employees and employees who prefer to work athome.

3. The objective of the Japanese style of "work-at-home"

The "work-at-home" concept is not new. Up until recently there have been three main types of "work-at-home" jobs as shown in Fig.1. The first category generally includes individuals with special talents; the second category includes professionals who have their to own private office or clinic; and the third includes work that may be isolated because of its specialized nature.

The "work-at-home" concept discussed here differs greatly from the conventional sense of the term as discribed above.

In our new type of "work-at-home" concept the individual is not isolated, but is closely related with other persons and types of jobs. He/she thus requires frequent communication of information at various stages of the working process. Although the individuals may be geographically scattered, they require access to the means of production through computer and communication technology.

A.Tofler's "electronic college" is an example of working environment of the near future, this concept, however, is not realistic in Japan right now. This is mainly because the Japanese mind still tend to be oriented toward group behavior rather than individual behavior, and also making because space to work at home is often difficult in Japanese homes. There are other difficulties such as job management, expenditure control, and keeping up with new technology in the home environment.

As a solution to these problems, we propose the concept of a "satellite office" as the Japanese style "work-at-home" concept. That is, a kind of remote office, as illustrated in Fig.2 and Fig.3. The satellite office is located close to the home and is equipped with workstations and communication equipment, which are connected to host computers through a telecommunication network. A small group of people from the same company work in the satellite office, just as they would in their head office or related plants.

Furthermore, people with different types of jobs and belonging to different companies may work in a satellite office together, participating in their own productive work but still monitaining close contact with their companies. This type of work place is "open to the public" and is available to anyone who would like to use it any time they desire.

The "satellite office" will thus be suited to persons who would find it difficult to work in a mormal urban environment, far from their home. It will also contribute to the development of rura lareas by providing employment opportunity in high-technology industries.

4. The C&C Satellite Office Concept

The C&C Satellite Office provides OA equipment with communication features and remote management functions. These offices intend to create a work place for skilled jobs, for example software engineering, and are distributed throughout residential areas and/or rural areas.

An example of a C&C Satellite Office used for software development is illustrated in Fig.4.

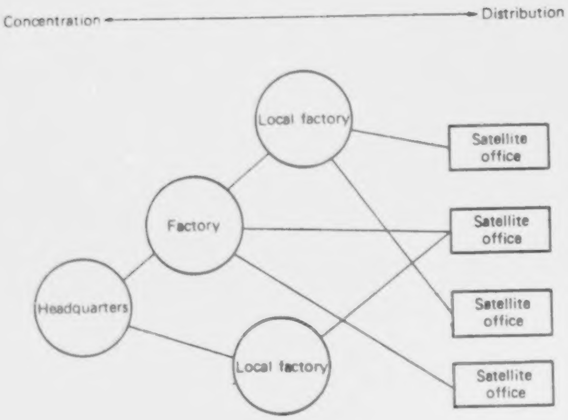
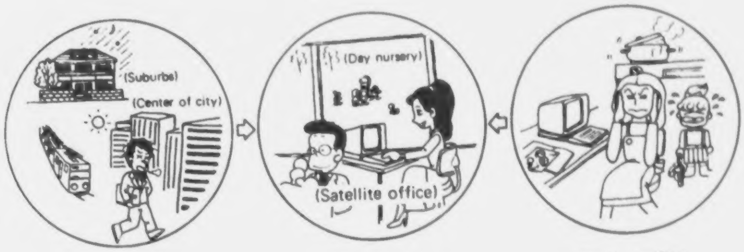


Figure 3 SITUATION OF SATELLITE OFFICE

The "C&C Satellite Office" in Fig.4 provides computer terminals for software development, OA equipment for communication and office work, and an office security system.

The development of software is complex in that it in corporates many steps and usually involves a number of software engineers.Thus, there is a necessity to control the development activities of engineer in both the satellite office and the software development division.

The office control division provides office facility management, including management of the satellite office. It provides security control, and operational and maintenance management forvarious equipment and OA systems. The satellite offices operate well only if these management control services are provided adequately. Consequently the satellite offices have to be linked with these management control divisions via various type of communication media such as a telephone network, a data network and an Integrated Services Digital Network(ISDN). Since communications of a satellite office may involve more than one division of a company, they must be implemented on a network. This network also enables the



City office (Conventional type)

Satellite office

Resident office

Figure 2 IN SEARCH OF THE NEAR FUTURE WORKING PLACE OF THE "C&C" AGE

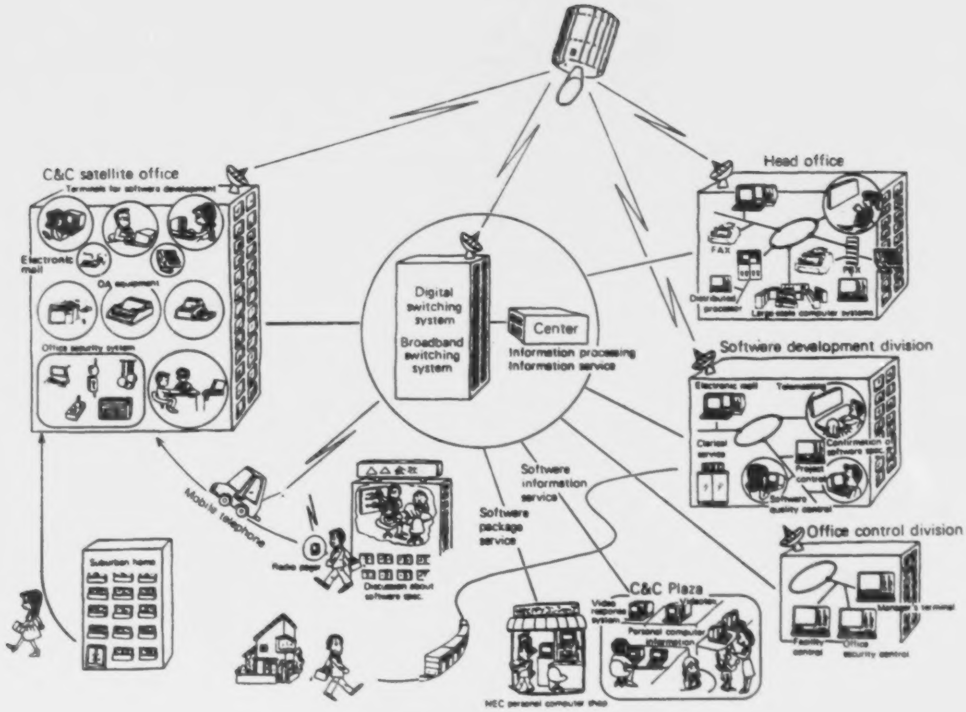

C&C satellite office
Terminals for software development
Electronic mail
OA equipment
Office security system
Digital switching system
Broadband switching system
Center
Information processing
Information service
Head office
FAX
PBX
Distributed processor
Large-scale computer systems
Software development division
Electronic mail
Teleconferencing
Clerical service
Confirmation of software spec.
Project control
Software quality control
Office control division
Manager's terminal
Facility control
Office security control
Mobile telephone
Radio pager
Discussion about software spec.
Software information service
Software package service
Suburban home
C&C Plaza
Video response system
Videotex
Personal computer information
NEC personal computer shop

Figure 4 C&C SATELLITE OFFICE IMAGE

concentration and distribution of software products, as well as instructions and communications for jobs.

5. The role of the telecommunication network

People working at the satellite office carry out their jobs using various types of OA equipment and communication facilities, however the satellite office itself is controlled and maintained remotely as mentioned in the previous section. The employees can work as if they were at the head office or the plants by accessing the host computer or related persons via various kinds of communication facilities.

The telecommunication network required for the satellite office will have to have the following features;

(1) A variety of communication services for conversation,eleconferences, graphics and text transfer, such as telephone, facsimile, teletext and video-conference services.

(2) Remote office monitoring and control features, such as remote personel management and remote office facility management.

(3) Free access from workstations used for software development and similar sophisticated jobs to the host computer via a network, such as data communication.

The network required will combine a public telephone network,a public data network, a public facsimile network and a private network which consists of dedicated lines.

The actual network will have more complex forms and hierarchical structures as companies vary in size, distribution area, management policy and background.

The satellite office system including the communication network will have to meet those various requirements at a resonable cost, that is a cost comparable with the system provided by an ordinary office.

Present telecommunication networks, especially common carrier networks, have separate configurations for respective services because each service was introduced individually at different stages of development.

Developments in digital communication technology and microelectronics have lead to ISDN which aims at integrating different services into a single digital network. An ISDN will offer a wide variety of services with the following features:

(1) Digital one-link connection between customer premises.

(2) Multiple and flexible connections of voice and non-voice terminals on a single line.

It will be realized to use at a reasonable cost.

As the telecommunication network and it's services are essential for the satellite office to transfer all sorts of information, an advanced telecommunication network like an ISDN is most suitable for it.

6. The of C&C Satellite Office experiment

6.1 Participation in the INS experimental project

In Japan, NTT(Nippon Telegraph and Telephone Corporation) inaugurated a large-scale experimental project called INS(Information Network System), a Japanese version of ISDN. The project was carried our in the Mitaka and Musashino areas and apart of central Tokyo, and began in September 1984. The services provided by this project are roughly divided into the 64 kbps and broadband services as summerized in Table 1.

In order to develop the applications and to evaluate the merit of the INS through actual use, participants were invited as monitors to use this system and as information providers to provide various information for the system.

NEC participated both as a monitor and a information provider,as well as joint developer of the system. An overall view of NEC's participation in the project is illustrated in Fig.5. Three NEC locations, the Personal Computer Store, the C&C Satellite Office and the C&C plaza, as well as four individual NEC employees participated in this project. To establish a distributed software production environment and related technologies, the first mode of a C&C Satellite Office was selected as one of NEC's facilities for the project. This office has been operating in Kichijoji of Musashino city since September 1984.

6.2 An outline of the model C&C Satellite Office

Table 1 EXAMPLES OF INS MODEL SYSTEM SERVICES

Category	Service	Transmission rate (brandwidth)
64 kbps services	Telephone	64 kbps
	Facsimile	64 kbps, 16 kbps
	Still picture service (videotex)	64 kbps, 16 kbps
	Telewriting service	16 kbps
	Message service	Existing data communication
Broadband services	Video teleconference	4 MHz
	Video telephone	4 MHz
	VRS	4 MHz
	Ultra-high speed facsimile	0.77 Mbps

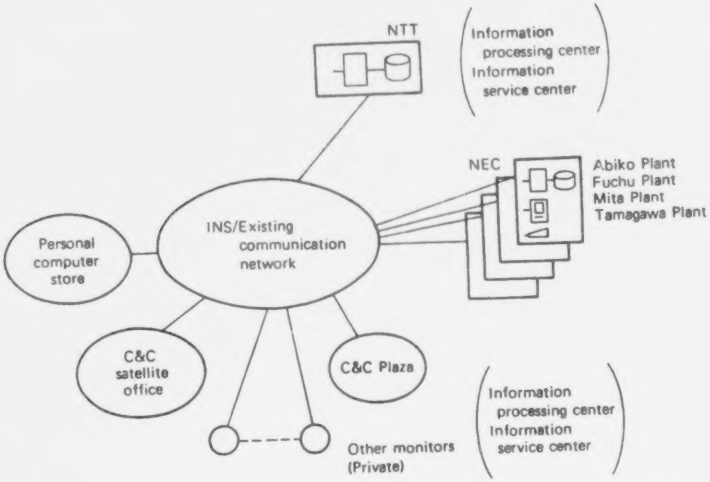

NTT
Information processing center
Information service center
NEC
Abiko Plant
Fuchu Plant
Mita Plant
Tamagawa Plant
INS/Existing communication network
Personal computer store
C&C satellite office
C&C Plaza
Other monitors (Private)
Information processing center
Information service center

Figure 5 A PLAN OF NEC'S PARTICIPATION AS INS MODEL SYSTEM MONITOR

Table 2 OUTLINE OF C&C MODEL SATELLITE OFFICE

1. Location: Kichijoji, Musashino-Shi, Tokyo.
Vallore Kichijoji 2 Buildiing

2. Foloor Space: Approx. 160 cm^2

3. Number of workers: 10

4. Facility:
- Software Production Equipment:
  - Personal computers, multifunction terminals, graphic terminals, and NTT's data terminals.
- INS Equipment (provided by NTT):
  - Digital telephone terminals,digital facsimile, digital still-picture terminal, and VRS terminal.
- Office Operation Facility:
  - Digital switchboard, telephone sets, facsimile terminals, and integrated OA terminals.
  - Office management system.
  - ITV monitoring system.
- Host Computers:
  - Located at existing computer centers at Tamagawa, Fuchu, Abiko, and Mita Plants.
  - ACOS1000 / 950 / 750 / 550 / 450, minicomputers, and DIPS (Denden Information Processing System) Centers.

The aims of the C&C Satellite Office experiment were to achieve (1) software engineering, (2) remote personel management, (3)remote office facility management, and (4) to develop OA equipment for satellite offices, and to examine the feasibility of a distributed software production system.

The model office occupies a small floor space for about ten software engineers and is located in a suburban area, residential area, some 20 kilometers away from the center of Tokyo. It is thus suitably removed in location from the head office and the related plants for this experiment. It was designed according to systematic, functional and ergonomic design methodology in order to produce a better software development environment. An outline of the satellite office is given in Table 2, and its layout is shown Fig.6 and Photo 1.

The telecommunication networks required for the model office needed to provide three kinds of facilities:

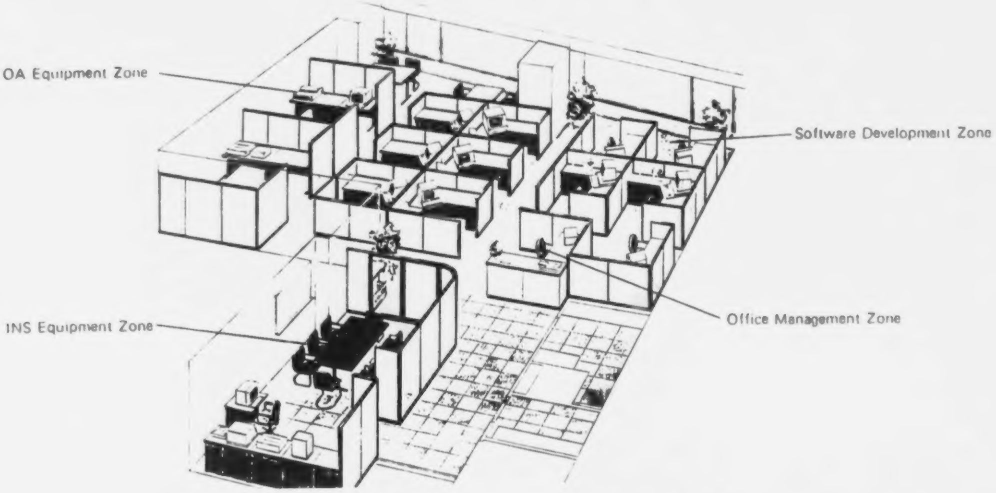
(1) Conventional communications such as telephone, facsimile,

(2) Remote office control and management including ITV(industrial television),

(3) Computer access for software production.

Consequently a network was constructed combining the INS, ordinary public networks and NEC private networks because the INS did not cover NEC's related plants and could not offer the sufficieht terminals. An outline of the network is given in Fig.7.

Another reason for using variety of networks was to provide an opportunity to study the advantages of each type of network.



- OA Equipment Zone:
  Equipped with facsimile, copy machine, multifunction OA terminal, and other common OA equipment .
- Software Development Zone:
  Partitioned for individual workers for software development activities. Terminals are placed on an L-shaped desk.
- Office Management Zone:
  Equipped with a personal computer and other equipment for awareness and welfare management and display and operation. for office management system.
- INS Equipment Zone:
  Equipped with INS digital equipment to allow experiencing and evaluation of the INS services.

Figure 6 SATELLITE OFFICE LAYOUT

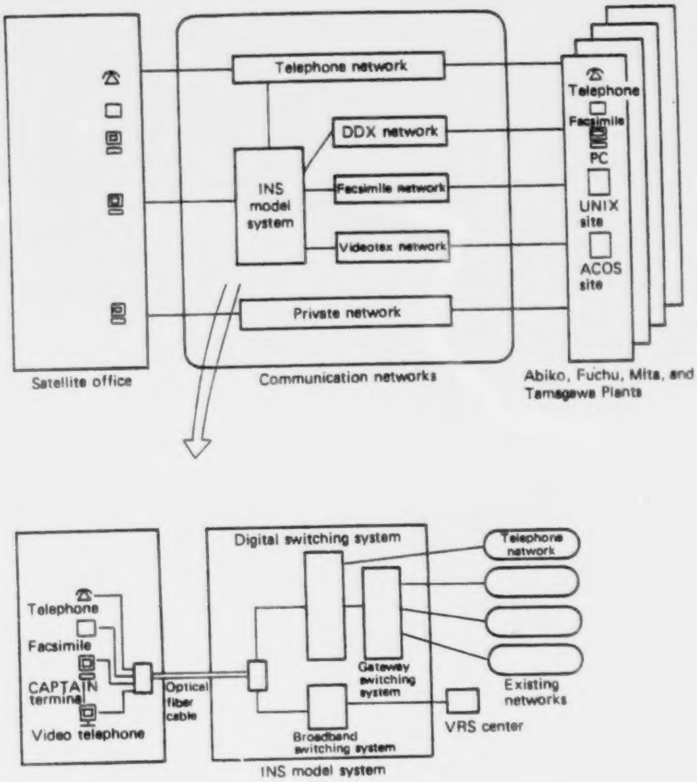

Telephone network
DDX network
INS model system
Facsimile network
Videotex network
Private network
Satellite office
Communication networks
Telephone
Facsimile
PC
UNIX site
ACOS site
Abiko, Fuchu, Mita, and Tamagawa Plants
Digital switching system
Telephone network
Telephone
Facsimile
CAPTAIN terminal
Video telephone
Optical fiber cable
Gateway switching system
Broadband switching system
Existing networks
VRS center
INS model system

Figure 7 CONFIGURATION OF THE SATELLITE OFFICE NETWORK

Table 3 EXAMPLES OF EXPERIMENT JOB

Item	Field		
	Information processing	Switching system	Transmission and terminal
Compiler development	○		
OS development	○		
UNIX network evaluation	○		
System analysis and engineering suppprt	○		
Improvement of compiler functions		○	
Firmware degsign		○	○
Design database construction		○	
Diagnostic program development		○	
OA system software development	○		○
Subscript termonal software development		○	○
Large-scale data processing system development	○		
OA software development	○		

6.3 Work at the satellite office and its evaluation

More than 70 software engineers from the head office and four plants participated to work for a few months each over a two year period. They participated in software development for computer and communication systems as a continuation of their job from their original office. Some examples are shown in Table 3.

The engineers working in the satellite office were able to access the various host computers located at their plants through the network via the workstations, that is personal computers or the multifunction terminals. They were instructed and supervised by their supervisors remotely though the various communication facilities which they also used actively for communications in the course of software development.

They used ID cards to obtain permission to enter or exit the office, check-in and check-out, and to activate their workstations. Thus,management data was easily obtained and the security of the office was maintained. Providing a safe and comfortable working environment, the satellite office itself was remotly supervisedand controlled by the remote office management system which waslinked to the office control division of the Mita plant. This system controlled the power for lights, office equipment and airconditioning, supervised fire, water leakage and illegal entrance, and monitored the office using ITV cameras.

Although this experiment will continue until next March, the intermediate results may be evaluated by analyzing the office functions, performance of the software produced, and reports from the participants.

The following results have been obtained:

(1) Work efficiency and the quality of products produced was equal to, if not better than those produced in an ordinary large office or plant environment.

(2) System design provid unsuitable for this type of office as meetings with customers and group studies are required.

(3) Coorperation of the head office and related plants is also necessary to improve database faciritles, available for engineering documents and technical information.

(4) The engineers who participated claimed they enjoyedgreater private time by saving commuting time.

(5) Women in the late stage of pregnancy and women withyoung babies were able to confortably continue their jobs.

(6) The office was sufficiently supervised and controlled by a remote office management system.

(7) Videoconferences, electric mail, telewriting and highspeed facsimile are useful services offered by the INSmodel system. However there is still only very limited information available by videotex and VRS(video response system) for business use. More information needs to be developed to make those media useful.

Thus, the experiment has proved fruitful in that it provided an actual situation in which to evaluate the merits and demerits of a satellite office and the related telecommunication facilities.

7. Development of future applications of the satellite office

With the introduction of ISDN, existing telecommunication media and services, that is telephone and data communication will diversify and will be available on request anywhere at a resonable cost. Also, further development of workstations and multifunctional terminals will offer better man-machine interfaces and enhance work at satellite offices.

As already mentioned, the need to provide better working environments and more opportunities for work are increasing in the information society because of the increase in intellectual jobs.

Based on these technical and social perspectives and the results of the experimental project of the C&C Satellite Office, NEC has been developing several types of application of the satellite office which will be put into practical use in the near future.

Some examples include:

(1) The individual use of a satellite office which is occupied by a company in order to carry out information oriented jobs like NEC's experimental satellite office.

(2) The shared use of a satellite office which is located at hotel, a local community or a rural business area, which is shared sometimes by persons belonging to different organizations.

This type of office is may be useful to travelling business men/women who need a temporary office and to the small enterprises who have not been install the latest OA equipment and telecommunication facilities like workstations and videoconference facility, as a working place "opened to the public".

(3) A transportable type satellite office which provides OA equipment and communication facilities and may be moved to construction sites and/or exhibition sites.

Mini satellite communication system and digital subscriber microwave systems are suitable for these applications because theyare easy to install.

Another varieties of applications will be realized in accordance with the recognition of the merits of the satellite office.

8. Conclusion

The C&C Satellite Office was introduced as a new type of office suitable for the information society of the future and is providing a solution to some of the social issues facing oursociety today. As a concrete example, the experiment of a satellite office being used for software development was given. Afeasibility study of the C&C Satellite Office in the INS model system experiment has been successfully conducted and useful results have been obtained to concerning the practical use of the satellite office.

A variety of applications of the satellite office in the C&C era, information age, will be developed, being supported by advanced telecommunication facilities like ISDN.

The satellite office will create a new working environment not only in a urban areas but also in rural areas and islands. It will contribute to the solution of social issues that have recently risen by offering an altenative working environment. NEC looks forward to playing an active role in developing and installing C&C Satellite Offices.

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Photograph 1 C&C SATELLITE OFFICE

The Key Aspects of Software Quality
and
Management Systems

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ABSTRACT

FUJITSU is making diverse efforts for quality assurance over the entire software life cycle by ascertaining what is software quality in its broadest sense. In the belief that software quality can be improved most effectively by eliminating the effect of "human errors," these efforts focus especially on standardizing and automizing all software development and control work as well as invigorating software engineers and workers.
Furthermore, we are concentrating on the quality visualization and stabilization for the purpose of quicker, more efficient software quality evaluation.
As a consequence, high quality software is now being produced at FUJITSU, with far fewer oversights of errors (bugs) and a remarkable reduction in the quality irregularities.

1. INTRODUCTION

The telecommunications system has thus far been operated mainly for telephone switching services. Recent technological evolution has ushered in the advanced information society, and we are witnessing the rapid emergence of a composite information telecommunication system providing a great variety of services through the combination of many kinds of data including digital data, image data, and audio signals. Representative of this trend are the ISDN (Integrated Services Digital Network) and the VAN (Value Added Network).

While advanced software is indispensable to realize this new telecommunications system, high reliability is also an essential prerequisite to satisfactory operation. At the moment, however, software quality control technology, the key to high reliability assurance for the system, is not established yet, although a variety of attempts are being made toward its development.

This report introduces FUJITSU's basic concept regarding software quality and its efforts in software quality assurance.

2. FUNDAMENTAL APPROACH TO SOFTWARE QUALITY ASSURANCE

2.1 Software Life Cycle and Quality Assurance

Figure 1 shows FUJITSU's concept of the software life cycle. In every phase of this life cycle, we are doing our utmost for software quality assurance.

This work is not done by our control department alone. Software quality assurance is a team effort undertaken by the control department and the development department. Specifically, the development department builds up the required quality in each phase of the software life cycle, while the control department sets up the quality index and checks each phase of the quality building process.

In this way, we are tackling the task of assuring high software quality throughout the entire software life cycle on the principle of total worker participation.

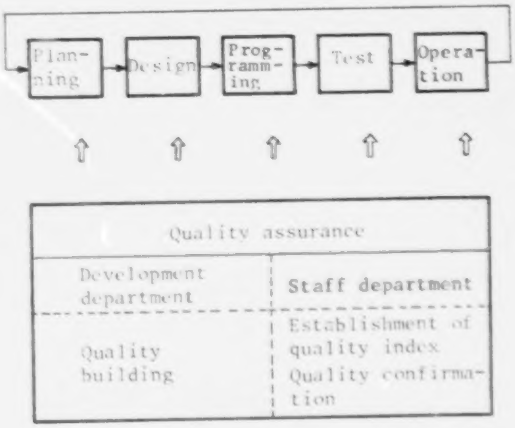


Fig. 1 Software Life Cycle

2.2 Software Quality

The term "software quality" is often constructed as meaning reliability or conformity to the specification. However, we interpret it in a much broader sense, regarding it as the "degree of customer satisfaction" which has three important aspects as shown in Figure 2.

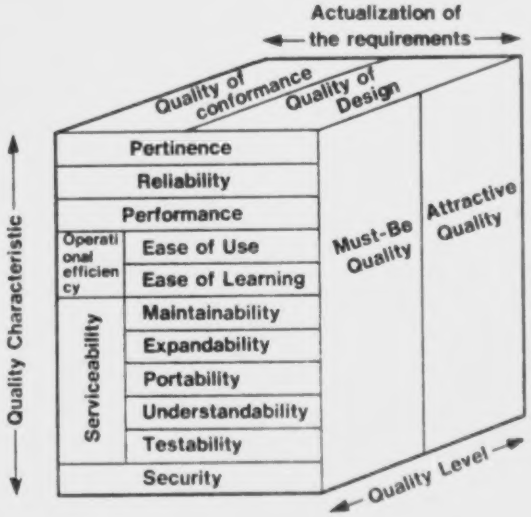


Fig. 2 Software Quality

(1) Quality characteristics

The quality characteristics are the items for quality evaluation; there are 11 such characteristics as shown in Figure 2.

(2) Quality of design and Quality of conformance

These indicate the degree to which quality requirements have been fulfilled.

1) Quality of design
Conformity between the user demands and the software specification.

2) Quality of conformance
Conformity between the software specification and the completed software.

(3) Must-be quality and Attractive quality

These indicate the level of quality.

1) Must-be quality
The quality level which is accepted as a matter of course if it is attained, and provokes customer dissatisfaction and complaints if it is not attained.

2) Attractive quality
The quality level which affords satisfaction to customers if it is attained, but does not arouse complaints if not attained.

3. EFFORTS FOR SOFTWARE QUALITY ASSURANCE

The existing state of software development presents a number of problems. For example, there are many cases where errors overlooked in the design or programming process are detected in the test process, but the undetected error rate varies largely from worker to worker not just in the design and programming processes but also in the test process.

Statistical quality control using the data from the entire software life cycle is a desirable, effective means of resolving these problems for software quality assurance. However, the technique for such statistical control is not established yet, although a variety of researches are being made toward its development.

To resolve these problems, we are concentrating on the human aspects of the software development process in addition to the statistical quality control technique.

Many research papers report that software quality is influenced largely by the ability, knowledge and experience of individual software engineers. We know this for a fact from our own experience, which tells us that 60% of all bugs are caused by human errors; the percent defective registered by those workers who produced the largest number of defective being more than 10 times the level recorded by those who produced the least number of defectives. This is because software is an intelligent personal product. The influence of human errors on software quality is thus very serious, and its elimination is certain to contribute greatly to improving software quality.

Three areas we are attending to are:

1) Making the quality of manual work uniform, i.e., standardization.

2) Diminishing the room for manual work and consequently human errors, i.e., automization.

3) Stimulating worker enthusiasm, i.e., worker invigoration.

3.1 Standardization

The purpose of standardization is to assure that the product manufactured by any worker will have the same, specified quality, by unifying and simplifying the product specifications and work methods and by applying such standardized specifications and methods in a systematic manner.

3.1.1 Target Areas of Standardization

The targets of standardization can be classified as follows:

1) Work method, e.g., development process.

2) Method of quality measurement.

3) General control rules, e.g., terms.

The contents of standardization varies largely from target to target. For some only an outline is stipulated. For others, the contents are prescribed in detail. The stringency of standard application is classified as shown in Table 1.

Table 1 Standard Application Criteria

Symbol	Name	Meaning
R	Rule	The standard that needs to be applied.
S	Standard	The standard that should preferably be applied if applicable.
L	Local standard	The standard to be applied in limited sectors/cases.

Figure 3 shows the work method standardization. It can be seen that standardization is effected by process division that applies to the whole software development process. The contents of work in each process are separately provided for in detail.

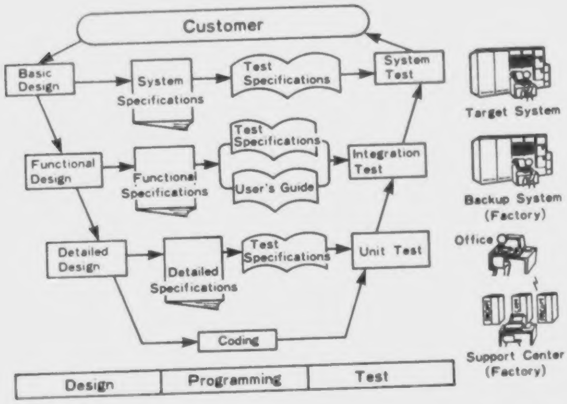
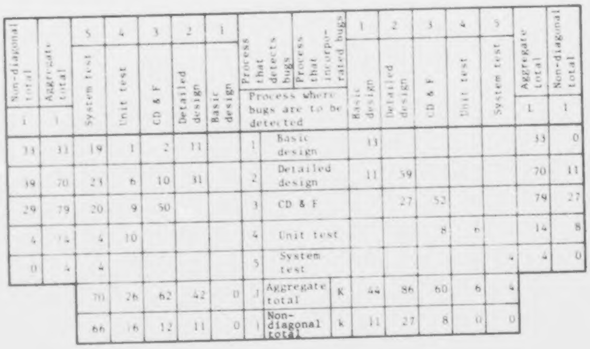


Fig. 3 Telecommuinications Software Development Phase

Figure 4 is an example of standardization of the method of quality measurement. This method is called the T-type Analysis, in which the T-type matrix shows the process that detects bugs, the process that incorporates bugs, and the process where bugs are to be detected, in order to clarify the processes that miss bugs and the processes with deficient bug-detecting technique.



Non-diagonal total	Aggregate total	5	4	3	2	1	Process that detects bugs	Process that incorporated bugs	1	2	3	4	5	Aggregate total	Non-diagonal total
I	I	System test	Unit test	CD & F	Detailed design	Basic design	Process where bugs are to be detected		Basic design	Detailed design	CD & F	Unit test	System test	L	l
33	33	19	1	2	11		1	Basic design	33					33	0
39	70	23	6	10	31		2	Detailed design	11	59				70	11
29	79	20	9	50			3	CD & F		27	52			79	27
4	14	4	10				4	Unit test			8	6		14	8
0	4	4					5	System test					4	4	0
		70	26	62	42	0	J	Aggregate total K	44	86	60	6	4		
		66	16	12	11	0	j	Non-diagonal total k	11	27	8	0	0		

Fig. 4 T-type Analysis

By standardizing other targets such as work movement, routing, method, job notion, etc., we have developed a standardization specification called the SEN (Software Engineering Norm for Telecommunication Software Development), shown in Table 2.

Table 2 SEN for Telecommunication Software Development

	000	100	200	300	400	500	600	900
	General rules	Document	Specification	Development work	Control	Effectuation	Education	Others
00	000			300	400	500	600	
	SEN standardization rules			Development work in general	Software control in general	Effectuation in general	Education in general	
10		110	210	310	410	510	610	
		Writing method	Language	Plan	Progress process control	Software QA	New-comer education	
20		120	220	320	420			
		Terminology	OS	System study	Production			
		130	230	330				
80		System	Pro	[illegible]	480			
			control system	Maintenance				
90				390	490			
				Evaluation	Outside order control			

3.1.2 Formulation and Reinforcement of Standards

The standards are formulated by generalizing and systematizing superior techniques developed and used by the development department. They also incorporate techniques developed by the control department as well as those upgraded by FUJITSU to the applicable level from remnants of initial development stages at outside research institutions.

Since all standards incorporate such application techniques in a fixed, constant manner, they must be revised and upgraded constantly according to technological progress, to maintain their validity and to keep up with the rapid pace of innovation. Hence, we are intent on revising and enhancing them all the time by introducing advanced, new techniques.

3.1.3 Diffusion of Standards

There is no sense in formulating elaborate standards unless they are positively followed and applied. For this reason, we are conducting PR activities to promote their diffusion and at the same time providing the development department with guidance for their accelerated application.

Furthermore, all standards to be used at the software planning stage must be noted down and kept on record, and reports must be submitted after completion of each software development project to see if the standards have actually been applied as planned.

3.2 Automization

The purpose of automization is to secure uniformity in software quality by leaving as much manual work as possible to machines, thereby reducing human errors.

3.2.1 Object of Automization

Automization is promoted for the entire software life cycle. The following is an example of automization.

We have developed the "SDL Support System", intended to automize manual work in the software design process. In this system, specifications described in the SDL (Functional Specification and Description Language) are input to automatically generate state transition diagrams and other documents based on knowledge of switching service specifications, and to automatically generate called processing programs.

We also have automized the checking service required for software quality improvement. The "FUNCTOR (Function Checkor)" is one of the tools developed for this purpose.

Figure 5 shows an outline of FUNCTOR. The FUNCTOR uses 17 fundamental functions as basic check elements of the source program, and automatically detects violations of coding rules and simple program logical errors.

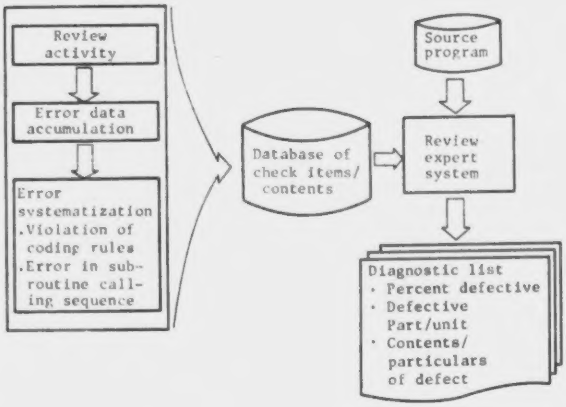
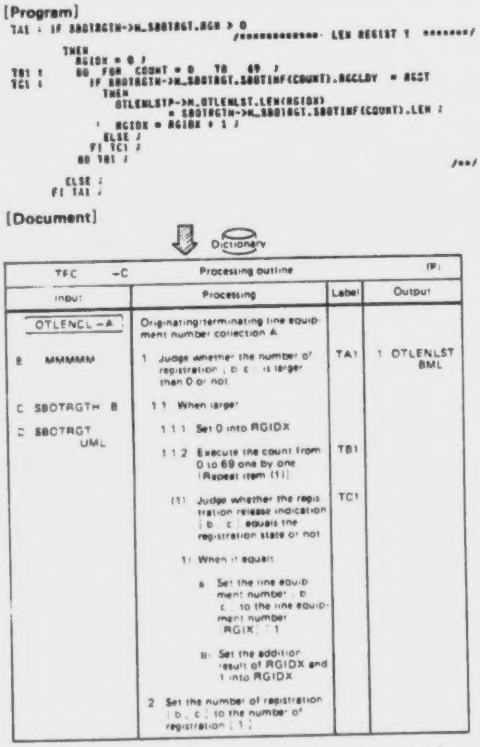


Fig. 5 Outline of FUNCTOR

In addition, we have the "DOCGEN (Automatic Document Generator)" developed to automatically generate documents like design drawings and specifications from the source program. The DOCGEN enables us to obtain the latest documents conforming to the source programs, and is highly effective in upgrading the quality of maintenance service needed for addition and alteration of software functions. Figure 6 shows an output example of the process outline sheet from the DOCGEN.



[Program]

```
TA1 : IF SBOTRGTH->M_SBOTRGT.RGN > 0
                                  /************ LEN REGIST ? *******/
        THEN
          RGIDX = 0 ;
TB1 :     DO  FOR  COUNT = 0   TO   69  ;
TC1 :       IF SBOTRGTH->M_SBOTRGT.SBOTINF(COUNT).REGLBY  = RGST
              THEN
                OTLENLSTP->M_OTLENLST.LEN(RGIDX)
                       = SBOTRGTH->M_SBOTRGT.SBOTINF(COUNT).LEN ;
            '  RGIDX = RGIDX + 1 ;
              ELSE ;
            FI TC1 ;
          OD TB1 ;                                                  /**/

        ELSE ;
      FI TA1 ;
```

[Document]

Dictionary

TFC —C	Processing outline		(P)
Input	Processing	Label	Output
OTLENCL —A	Originating/terminating line equipment number collection A		
B MMMMM	1 Judge whether the number of registration (b c) is larger than 0 or not	TA1	1 OTLENLST BML
C SBOTRGTH B	1.1 When larger		
D SBOTRGT UML	1.1.1 Set 0 into RGIDX		
	1.1.2 Execute the count from 0 to 69 one by one (Repeat item (1))	TB1	
	(1) Judge whether the registration release indication (b c) equals the registration state or not	TC1	
	1) When it equals		
	a Set the line equipment number (b c) to the line equipment number (RGIX) (1		
	b) Set the addition result of RGIDX and 1 into RGIDX		
	2 Set the number of registration (b, c) to the number of registration (1)		

Fig. 6 Automatic Output of a Processing Outline Specification

3.2.2 Diffusion of Tools

There is no sense in developing many useful tools unless they are fully utilized. For this reason, all useful tools owned by any department or project team are registered in the technical information file for easy retrieval of the required tool information by any individual or department. For tools which are particularly useful, technical bills are prepared and distributed to promote their application.

3.3 Worker Invigoration

Software development naturally calls for the availability of well-consolidated standards, advanced techniques and useful tools, but it is always the software engineer that uses such standards, techniques or tools. Unless he is willing to throw himself wholeheartedly into software development, it can hardly be expected that any high quality software will be produced. Thus worker invigoration is an important problem bearing closely on the software development and software quality assurance.

3.3.1 Objective of Worker Invigoration

Worker invigoration is aimed at stirring up job enthusiasm and inducing workers to take up "voluntary, self-initiated" improvements and creative activities.

By motivating each individual software engineer to excel in his work, not only can the entire organization be revitalized, but also the software quality and productivity can be greatly upgrated.

3.3.2 Method of Worker Invigoration

We are taking the following measures to promote our worker invigoration scheme.

1) Promote worker awareness of the spirit of Japanese-style quality control

   We imbibe all workers with the notion that "human beings inherently have the ability and inclination for development, and grow to reliable persons only if they are given the necessary training and education", and encourage them to think and act "voluntarily", at their own discretion.

2) Stimulate the competitive instinct and the desire to feel a sense of achievement from work.

3) Training in quality control techniques.

These measures are incorporated in our education/enlightenment system shown in Figure 7, and we have a worker commendation system instituted for the same purpose. Introduced below is part of these systems.

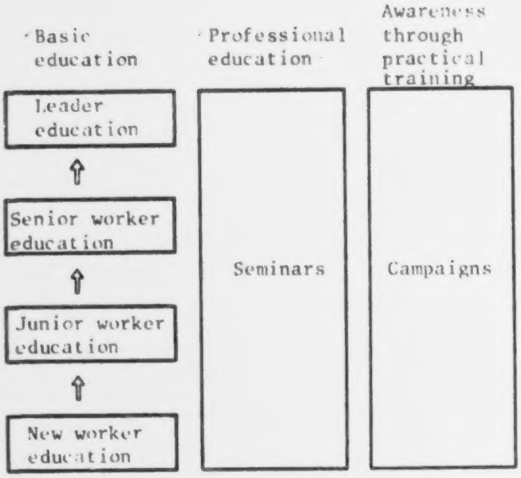


Fig. 7 Education/Enlightenment System

(1) Campaigns

Campaigns are organized for all software engineers for quality control group training and awareness. Each group of engineers conducts the campaign for a certain, specified period to attain a target established by a theme and slogan selected by all group members. The purpose is to acquire quality control technique through day-to-day activities. Table 3 shows some of the themes of campaign conducted in the past.

Table 3 Campaign Themes and Slogans (Example)

Theme	Slogan	Target
Review campaign	Let's have a go.	Quick detection of software bugs through careful review
NAZE NAZE campaign ("Why Why" campaign)	Let's get professional	Prevention of recurring software bugs through persistent pursuit and detection of true causes
ABC campaign	Let's reach the necessary level without a slip up (Atarimae no koto wo Bonyari sezuni Chanto yaru.)	Revitalization of software development work by following basic work methods and rules

Since all these campaigns are organized for a large number of workers, they are carried on not just in the campaign period. Specifically, pre- and post-campaign promotion activities are conducted for one month before and after the campaign period.

Figure 8 shows an outline of campaign promotion activities.

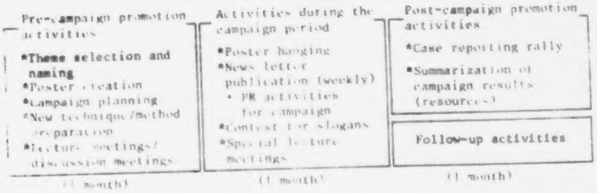

Pre-campaign promotion activities
*Theme selection and naming
*Poster creation
*Campaign planning
*New technique/method preparation
*Lecture meetings/ discussion meetings
(1 month)
Activities during the campaign period
*Poster hanging
*News letter publication (weekly)
• PR activities for campaign
*Contest for slogans
*Special lecture meetings
(1 month)
Post-campaign promotion activities
*Case reporting rally
*Summarization of campaign results (resources)
Follow-up activities
(1 month)

Fig. 8 Outline of Promotion Activities

(2) Seminars

Seminars are organized to provide professional education and training in quality control.

The "7 Tools for QC" for resolving quality problems using numerical data systematized in Japan as well as the "New 7 Tools for QC" for resolving quality problems using language data are applied at the seminars.

Also, use it made of the method called "S-MAP", developed for resolving minor problems encountered in the day-to-day software development work using the said QC tools. Figure 9 shows has process of clearing up the true causes of software bugs using the S-MAP.

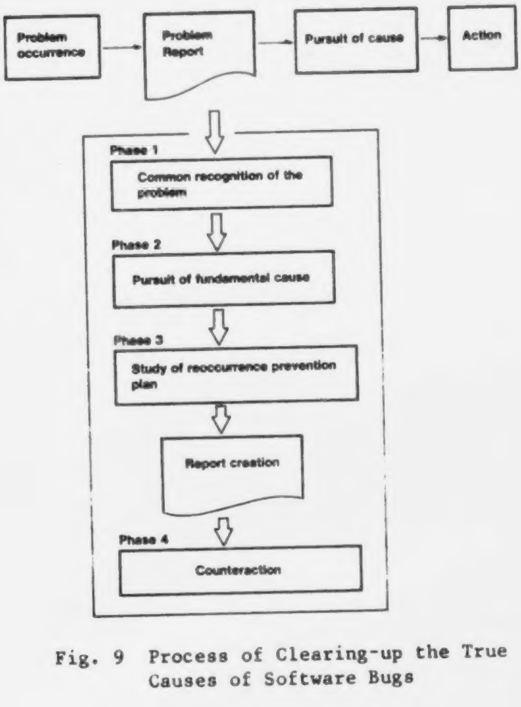

Problem occurrence
Problem Report
Pursuit of cause
Action
Phase 1
Common recognition of the problem
Phase 2
Pursuit of fundamental cause
Phase 3
Study of reoccurrence prevention plan
Report creation
Phase 4
Counteraction

Fig. 9 Process of Clearing-up the True Causes of Software Bugs

(3) Suggestions and Commendation System

FUJITSU has three drives now underway, the "High Reliability Program", "VE Promotion" and "Movement for Innovative Technology Creation".

These drives incorporate and are supported by two unique systems, the suggestions system under which all workers are encouraged to present their ideas and suggestions for work method improvement, and the commendation system under which workers who have contributed valuable ideas and suggestions are given official commendation. These systems give a great boost to "Worker invigoration".

4. SOFTWARE QUALITY EVALUATION

The quality evaluation technology, which is essential for quality control of general industrial products, has been developed by upgrading various techniques and know-how for objectively grasping the quality information, or the degree of badness, by quantifying it.

The software quality evaluation technology can also be developed in the same way. However, since it is still at an early stage of development, we are adopting the second best method in which the software quality state is grasped by macroscopic visualization. Needless to say, we are making steady efforts to develop new techniques and know-how for quantitative grasping of software quality.

4.1 Quality State Visualization

Figure 10 is a typical example of visualization. In this graph, the date is plotted along the abscissa and the module number along the ordinate, making it easy to see which module is updated on which date.

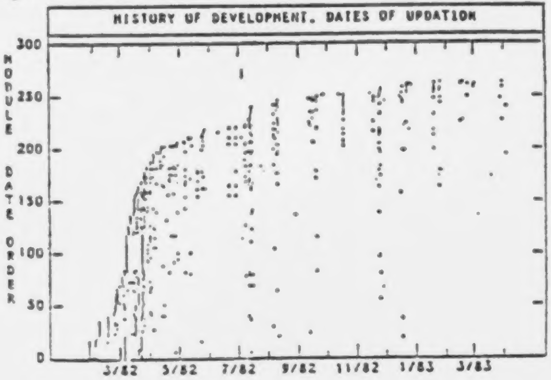


Fig. 10 Updated History Graph

The graph shows that the modules have been developed by stages. The modules with many black dots plotted horizontally are those which call for careful attention, and the dates with many black dots plotted perpendicularly indicate that file updating was conducted all at once.

This graph is output by a tool called the "ASDGEM (Analysis of Software Development History Recorded with GEM)" which automatically stores updated software history. The ASDGEM outputs more than 20 kinds of graphs on the graphic terminal in the conversation mode, and these are visualized from different viewpoints.

The output graph is analyzed by the development group, to recognize the progress of software development and quality problems and to reflect such progress and problems in the method of project implementation (Figure 11).

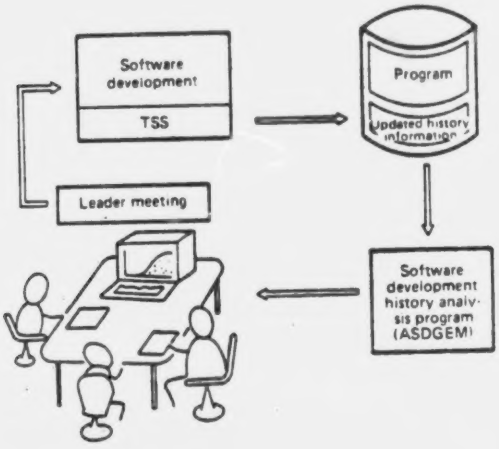

Software development
TSS
Program
Updated history information
Leader meeting
Software development history analysis program (ASDGEM)

Fig. 11 Visualization of Software Development State by ASDGEM

The "PROTT (Program Route Tracer)" is a tool for visualizing the test condition. Generally, most program bugs are brought to the fore after execution of at least one instruction. The PROTT records the address on the memory associated with the executed instruction, and outputs the results in the form of a graph. Accordingly, all instructions not executed can be discerned and the corresponding test conditions can be added.

Figure 12 shows an output example of a route tracing result. It can be said that the greater the black fields, the better the test performance.

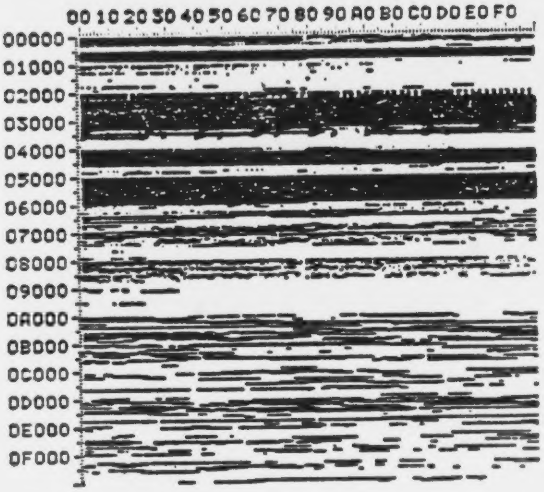


Fig. 12 Route Tracing

4.2 Software Quality Quantification

We have realized the quantification of software quality by classifying and placing it under a number of categories and breaking it down further to individual quality items for instrumentation. The software quality thus quantified is subjected to evaluation from each point of view of the user, designer and evaluator.

4.3 Quality Assurance System

All our operations for software quality assurance described above are conducted in an integrated, systematic manner under a communication software assurance system called the QACE (Quality Assurance of Communication Software), as shown in Figure 13.

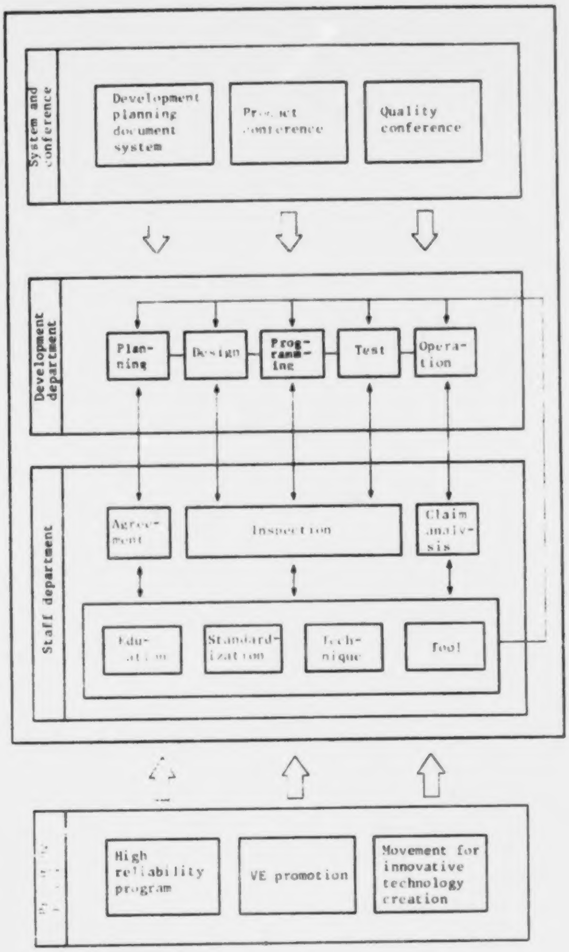

System and conference
Development planning document system
Product conference
Quality conference
Development department
Planning
Design
Programming
Test
Operation
Staff department
Agreement
Inspection
Claim analysis
Education
Standardization
Technique
Tool
High reliability program
VE promotion
Movement for innovative technology creation

Fig. 13 Quality Assurance System for Telecommunications Software

Telecommunication software development at FUJITSU is supported by these factors over the entire software life cycle covering planning, design, programming, test and operation. These factors are the supporting institutions and conferences, control department, and promotion activities.

5. CONCLUSION

As described above, we are making diverse efforts to improve software quality and productivity.

Figure 14 shows the condition of occurrence of software in the field in the 1-year period since the FETEX-150 Digital Exchange (cf. Table 4) developed by FUJITSU for overseas telephone offices was put into operation.

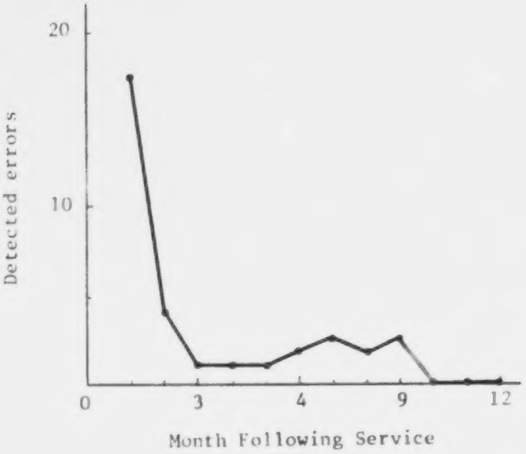


Fig. 14 Software Errors Since Service In

Table 4 Main Specifications of FETEX-150

o Capacity:	240,000	Lines
	60,000	Trunks
o Erlangs :	24,000	Erlangs
o BHCA :	1,000,000	BHCA

Services offered by the telecommunications system are becoming increasingly variegated and complex. System users are also showing marked diversification in terms of occupation, industrial or business area, and level. Efficient software development to cope with these rapid changes in the services and users of the telecommunications system is therefore an important, new challenge that we must apply ourselves to with all our might in the coming years.

We are convinced, however, that by upgrading software quality, we will also be able to improve its productivity, just as we experienced in hardware quality development in past years. This calls for quality building in each phase of software development, not just quality confirmation at the final test stage.

For all these reasons, we are determined to ascertain software quality on a quantitative case in each process of software development and to promote the visualization of quality building conditions.

SESSION 2

Rural and Remote Users

QUALITY SERVICE TO SMALL COMMUNITIES

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1.0 ABSTRACT

Telecommunications today plays an important role in developing countries which are ridden with problems like over population, wide area, lower ratio of revenue to communication cost, constraints on investment, differing requirements of rural and urban population etc. This paper describes the contribution of Indian Telephone Industries Ltd., towards meeting the quality communication service by way of providing electronic telephone exchanges for small communities.

2.0 INTRODUCTION

The small community definition in this paper covers the following:

a. A remote village where the exchange capacity required may vary from as low as 25 lines to 100 lines,
b. A small office located in an urban environment requiring both internal and external communication facilities with a capacity of 25 to 100 lines,
c. A small town or a medium scale industry requiring exchanges in the capacity range of 100 to 200 lines.
d. A large industry (like a coal mine, steel industry or railways) which has many centers distributed over a wide area requiring small exchanges for internal communication and networking facilities for intra-exchange communication.

Fig.1 shows various forms of the small community

Any system designed to provide quality service should meet the following requirements:

Easy user accessibility;
Maximum equipment availability and utility;
Operational simplicity;
Remote monitoring;
Online maintenance;
Reliability;
Support modern facilities with flexibility,
Capability to work with existing network,
Low initial cost;
Low operational and maintenance cost;
Modularity of growth for future expansion.

3.0 THE INDIAN SCENARIO

The scenario prevailing in India at present is made up of various forms of the above said small communities. The situation is similar in many other developing countries also. In India, it is known that 55% of the available 5 million telephones are connected to big exchanges in 34 cities and the rest are connected to about 11,000 exchanges of varying sizes (from as low as 25 lines to 1000 lines) in small towns. In order to have a satisfactory level of reach for telephones, it is required to provide more and more telephones in villages and small organizations. This enables better commercial transactions which have a bearing on the national economy. It is proposed to improve the existing level of telephone density (which is 5.01 per thousand population) to about four fold in the next 15 years to achieve reasonable communication and economical progress. In order to meet the above objective, there is a large requirement for economical, modular and multi-function switching systems.

4.0 THE I.T.I SOLUTION

The Switching R&D division of Indian Telephone Industries Ltd., accepted the challenge and came out with a family of switching systems to support the large volume requirement of small capacity exchanges. The design objectives set for the project were :

- a universal switching equipment which is modular, reliable, flexible and easy to expand,
- the equipment should be simple to manufacture and maintain catering initially for voice services only but upgradable for data services,
- suitable to work in Indian environment which has large temperature and humidity variations (temperatures as high as 50deg.Cent.,and relative humidity as high as 95%),
- suitable for a variety of applications

like PAXs, PABXs, RAXs and transit exchanges.

After a careful study the typical configurations required were evolved.

- A 24 line exchange expandable to 48 lines (scaled down version)
- A 100 line exchange expandable to 200 lines (stand alone version)
- A 200 line exchange expandable to 400 lines (two exchanges in handshake mode)
- 600, 800 and 1000 line exchanges implemented by networking 200 line stand alone exchanges with or without transit exchanges.
- A 112 line transit exchange for pure trunk switching functions in public network or for transit switching in case of networked exchanges.

These products were realised through the following design philosophy:

- Time Division Multiplex technique.
- Stored program control using microprocessors.
- Use of high level programming languages.
- Provisions for easy detection and isolation of faults.
- Introduction of remote monitoring facilities.
- Distributed processing techniques for networked exchanges.

The products that were developed and productionised were:

- A 24/48 line electronic private automatic exchange called EPAX 24/48
- A 200 line electronic private automatic exchange called EPAX 200
- A 200 line electronic private exchange with tielines called EPAX232T
- A 200 line electronic small automatic exchange called ESAX 200
- A 200 line electronic private branch exchange called TDBX 200
- A 112 line transit exchange called ETX 110.

The features of the various products are as given below.

EPAX 24/48 and EPAX 200

These exchanges are designed for intercommunication facilities for users ranging from 8 to 200 lines. They offer several useful facilities such as call diversion, call forwarding, call consultation, call hold, priority call connect, three party conference, ring when free, page call etc.

EPAX 232T

In this system tielines are provided to interwork with other electronic and electromechanical exchanges (with interfaces for radio and satellite links). This system provides a way of augmenting the existing communication facility by electronic exchanges. The number of tielines vary from 4 to 32 in steps of 4 lines. This system serves different nodes in a network.

ESAX 200

The ESAX 200 is designed to meet the needs of the rural users ranging from 8 lines to 200 lines. The system can work as a terminal exchange or as local cum transit exchange in the public telephone network. The system offers a variety of interfaces and features software metering.

TDBX 200

The TDBX 200 system offers all the facilities of EPAX besides special facilities like disturb-me-not, abbreviated dialling, call detail recording, etc. An operator friendly intelligent console handles very efficiently calls to and from the central office. Provisions are made for multiple consoles wherever necessary.

ETX 110

The ETX 110 transit exchange is used to interconnect many exchanges in the public or private network. This system also has interfaces to work with radio and satellite links.

5.0 TECHNICAL PHILOSOPHY

5.1 HARDWARE ARCHITECTURE

The block diagram of the generic system is shown in fig 2.
The control cards designed to handle the system switching functions are :

CPU Card-	Central processing unit having Zilog 80 microprocessor and 64 K bytes memory.
TTP Card-	Tone generation, timing generation and paging amplifier
NWC Card-	Network controller card which controls switching of calls
SDC Card-	Scanner card for scanning

hook states of telephone lines

EECI Card	EEPROM card for storing metering information.
DDCI Card-	Diagnostic display and communication controller card
STC Card-	System testing card for system diagnostic purposes.
SLC Card	Subscriber line card which houses 3 subscriber circuits
TLC Card-	Trunk card for various interfaces like PABX, manual board, coin box telephone, loop or E and M type tie line etc.

The hardware design is such that the system can be configured to any of the applications in an effective way. Utilising the above hardware modules, the system can be configured as a PAX (private automatic exchange), a PABX (private automatic branch exchange), an RAX (rural automatic exchange), a TAX (a trunk/transit exchange) or a PCN (a private communication network). A few specialised interfaces are used in some applications.

5.2 SOFTWARE ARCHITECTURE

The quantity and complexity of the software executed functions in the above family of electronic switching systems demand a strong functional and formal organisation which are assured by means of the following basic principles.

- Top down design
- Decentralisation of time critical functions
- Functional organisation of software modules
- Standardised communication between application program modules
- Structuring of programs and data
- Selective blend of assembly and high level programming language.

The major subsystems that constitute the system software are :

- The operating system which provides task scheduling message processing and interrupt handling.
- The operational programs which implement call processing
- The maintenance programs which provide diagnostic and house keeping.

The software architecture and the various functional modules are illustrated in fig.3a and fig.3b. The system software is modular and tailored to meet the various configurations with a comprehensive range of features and facilities.

6.0 APPLICATIONS OF THE VARIOUS PRODUCTS

Fig.4 shows the public rural communication network consisting of ESAX systems.
Fig.5 shows the office/industrial/commercial network consisting of EDAX and ETX systems.

7.0 THE PRODUCTION AND OPERATIONAL ECONOMY

The products developed above are having the advantage of lower cost of production as a result of efficient design concepts and simple but cost effective production set up. The production requirements are both capital sensitive and labour intensive.

PRODUCTION COST

A break up of the cost of TDBX 200 equipped with an operator console, 200 subscriber terminations and 32 central office junctions is presented below. The system comprises of 25 subscriber line cards, central office junction cards, an operator console, power supply and ringer.

COMPONENT COST

a.	Imported components with 100% duty	US$ 10,000
b.	Indigenous components	US$ 5,000
c.	Imported raw material for PCB	US$ 200
d.	Indigenous cost of cabinet, power supply, ringer, MDF etc	US$ 5,000
	Total cost	US$ 20,000

LABOUR COST

a.	Card assembly 6hrs/card	240 hrs
b.	Subrack assembly and wiring 10hrs/subrack	50 hrs
c.	Cabinet wiring	8 hrs
d.	Power supply and ringer assembly	20 hrs
e.	Card testing with test jig	25 hrs
f.	Power supply and ringer checking	8 hrs
g.	System testing with burn in for one week	50 hrs
	Total	401 hrs

Labour cost at US$ 1/hr	US$ 401
Manufacturing cost	US$ 20,601
Cost/line	US$ 100 (approx.)

EQUIPMENT REQUIRED FOR PRODUCTION

1 Active component tester
2 Passive component tester
3 Meg ohm meter
4 LCR Bridge
5 IC Tester
6 IC Handler
7 PCB Testing equipment.
8 Component forming equipment
9 Wave soldering equipment
10 Desoldering equipment
11 50MHz dual beam oscilloscope
12 Digital multimeter
13 Card tester of I.T.I design
14 EPROM Programmer
15 Wire wrapping tool
16 Back plane tester
17 Wire unwrapping tool
18 Crimping tool
19 IBM PC for system engineering, production and stock control
20 Bench top power supply 48V, 10A
21 Clip on current meter
22 Float charger and rectifier 120 AH

8.0 CONCLUSION

The quality service to small communities objective has been met by Indian Telephone Industries Ltd. through the introduction of a family of time division electronic exchanges. The systems exhibit low initial cost, modularity of growth, high reliability, low operation and maintenance cost, compatibility with existing and future systems etc. Besides, fewer types of hardware subsystems bring down plant inventory and maintenance spares. Reports on performance of already installed exchanges (about 50,000 lines) have confirmed that they are capable of working in the Indian environment quite effectively.

ACKNOWLEDGEMENTS

We are extremely thankful to the management of Indian Telephone Industries who were instrumental in development of this range of switching systems and also for granting permission to publish the work. We thank all the staff and engineers of small exchanges group and the central services group for their contribution in development of these products.

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4.0 ETX 110 system manual, Indian Telephone Industries Ltd.
5.0 TDBX 200 system manual, Indian Telephone Industries Ltd.
6.0 ESAX 200 system manual, Indian Telephone Industries Ltd.

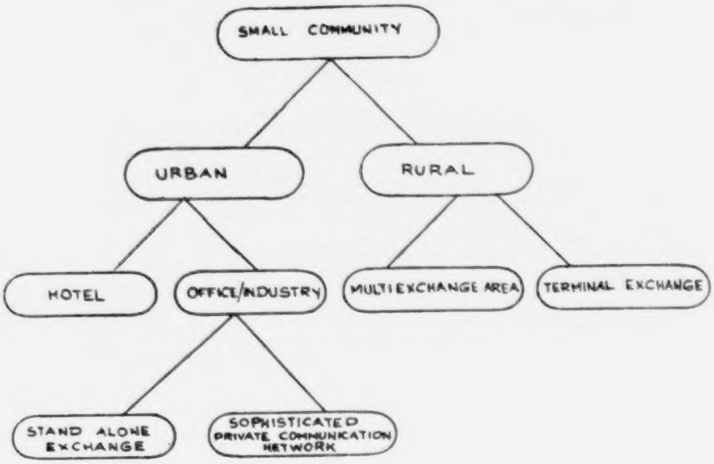

SMALL COMMUNITY
URBAN
RURAL
HOTEL
OFFICE/INDUSTRY
MULTI EXCHANGE AREA
TERMINAL EXCHANGE
STAND ALONE EXCHANGE
SOPHISTICATED PRIVATE COMMUNICATION NETWORK

FIG. 1
SMALL COMMUNITY TREE

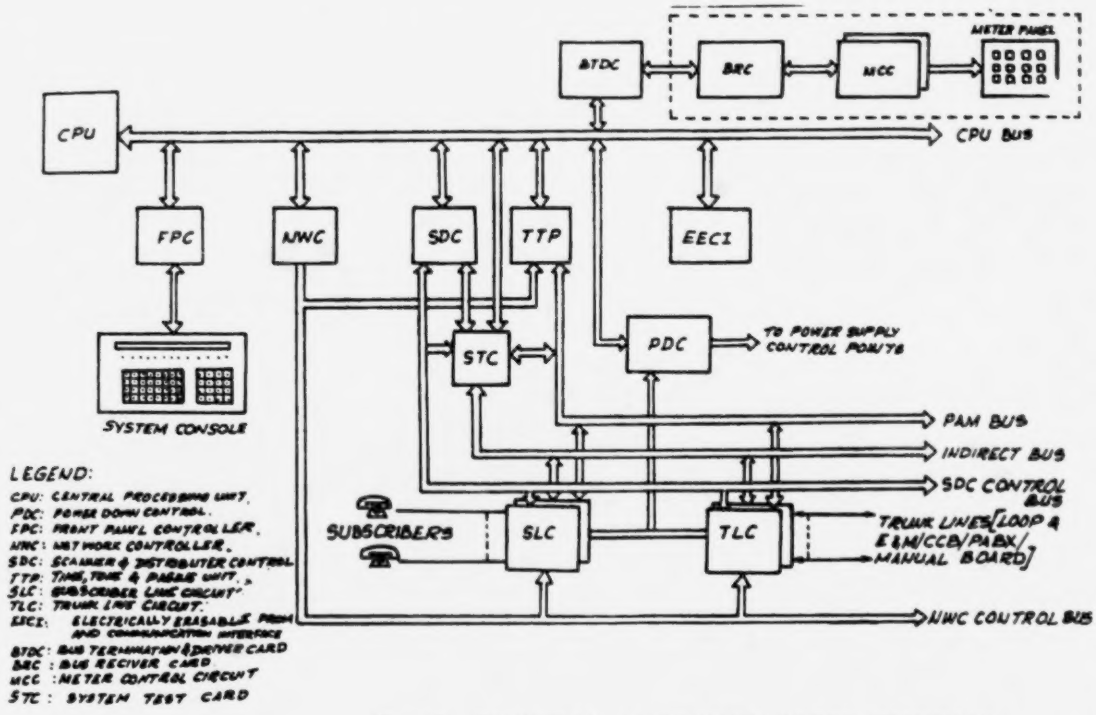

BTDC
BRC
MCC
METER PANEL
CPU
CPU BUS
FPC
NWC
SDC
TTP
EECI
STC
PDC
TO POWER SUPPLY CONTROL POINTS
SYSTEM CONSOLE
PAM BUS
INDIRECT BUS
SDC CONTROL BUS
SUBSCRIBERS
SLC
TLC
TRUNK LINES [LOOP & E&M/CCB/PABX/MANUAL BOARD]
NWC CONTROL BUS
LEGEND:
CPU: CENTRAL PROCESSING UNIT.
PDC: POWER DOWN CONTROL.
FPC: FRONT PANEL CONTROLLER.
NWC: NETWORK CONTROLLER.
SDC: SCANNER & DISTRIBUTER CONTROL
TTP: TIME, TONE & PABX UNIT.
SLC: SUBSCRIBER LINE CIRCUIT
TLC: TRUNK LINE CIRCUIT.
EECI: ELECTRICALLY ERASABLE PROM AND COMMUNICATION INTERFACE
BTDC: BUS TERMINATION & DRIVER CARD
BRC: BUS RECIVER CARD
MCC: METER CONTROL CIRCUIT
STC: SYSTEM TEST CARD

Fig 2. SYSTEM HARDWARE BLOCK DIAGRAM

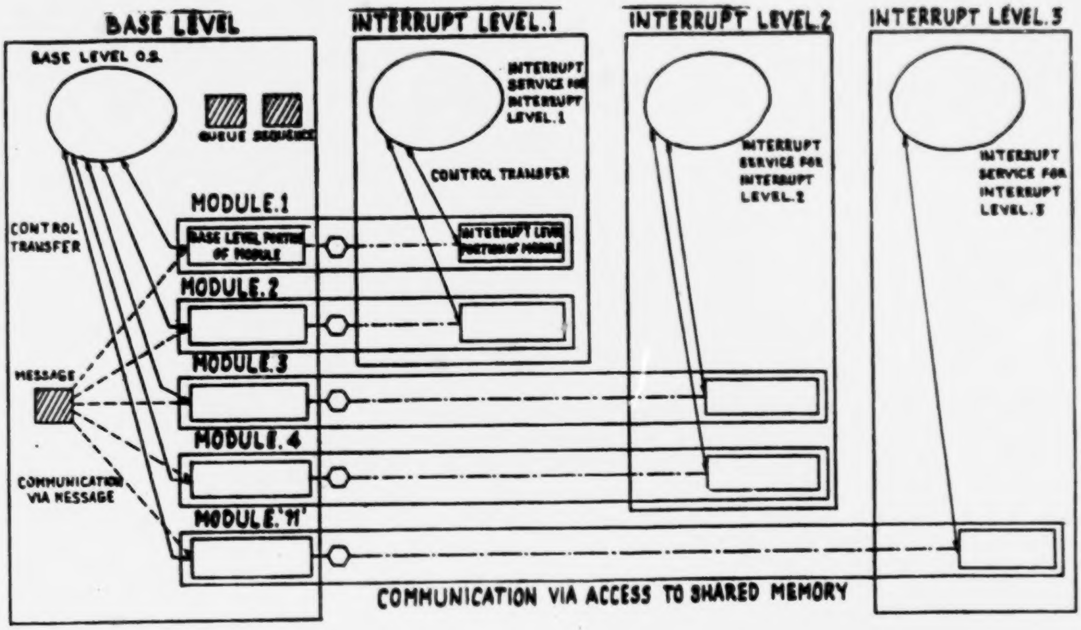

BASE LEVEL
INTERRUPT LEVEL.1
INTERRUPT LEVEL.2
INTERRUPT LEVEL.3
BASE LEVEL O.S.
QUEUE
SEQUENCE
INTERRUPT SERVICE FOR INTERRUPT LEVEL.1
CONTROL TRANSFER
INTERRUPT SERVICE FOR INTERRUPT LEVEL.2
INTERRUPT SERVICE FOR INTERRUPT LEVEL.3
CONTROL TRANSFER
MODULE.1
BASE LEVEL PORTION OF MODULE
INTERRUPT LEVEL PORTION OF MODULE
MODULE.2
MESSAGE
MODULE.3
MODULE.4
COMMUNICATION VIA MESSAGE
MODULE.'n'
COMMUNICATION VIA ACCESS TO SHARED MEMORY

Fig 3 a. SOFTWARE ARCHITECTURE (GENERAL)

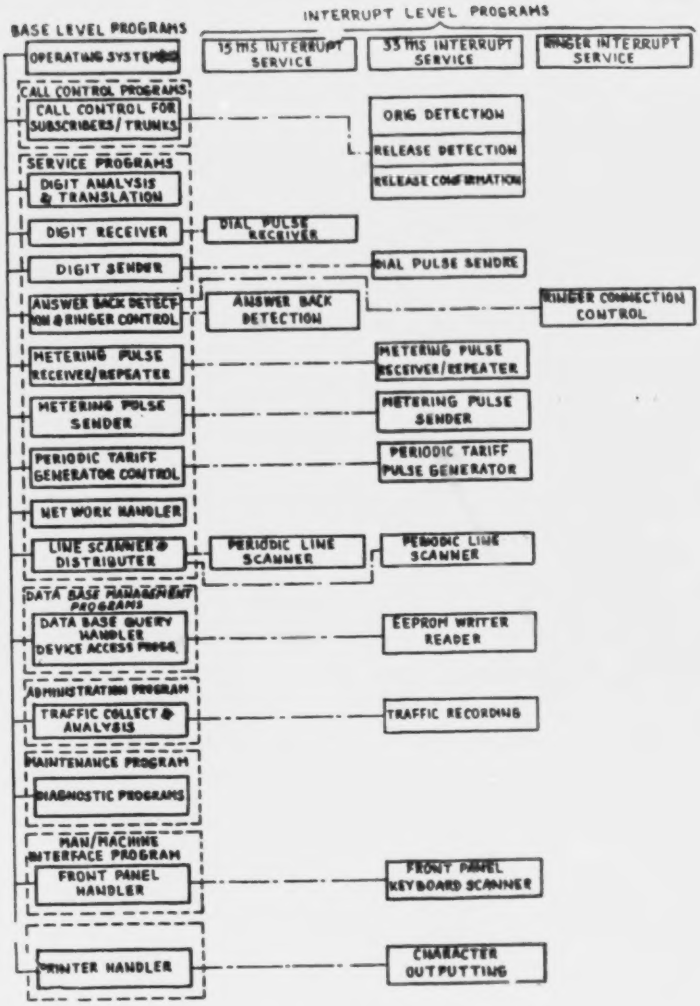
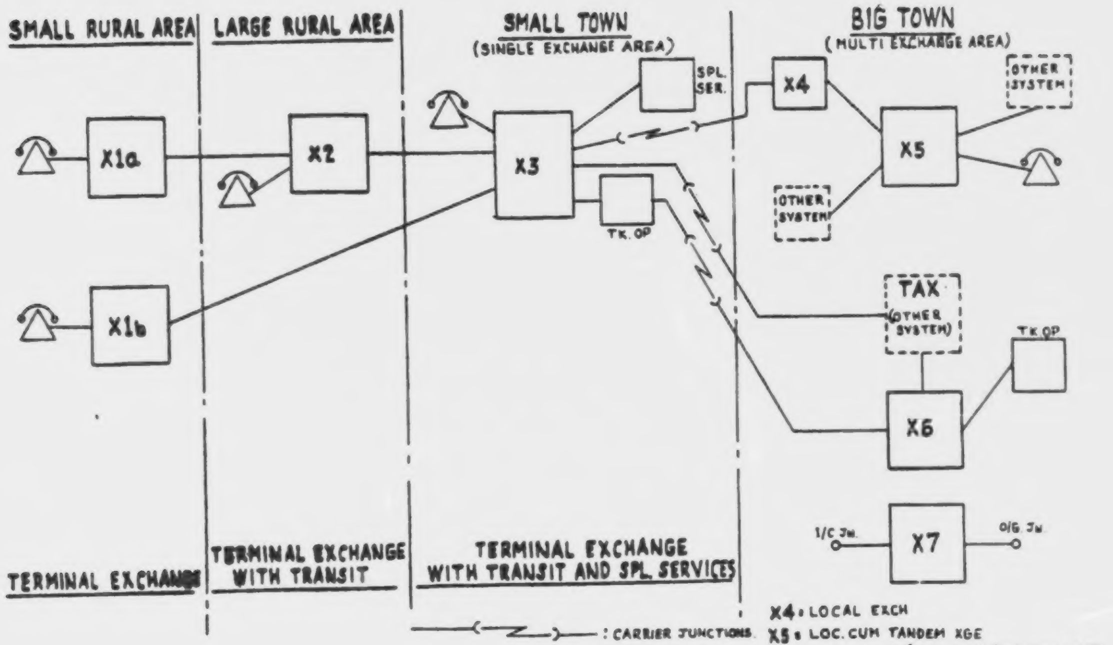

BASE LEVEL PROGRAMS
INTERRUPT LEVEL PROGRAMS
OPERATING SYSTEMS
15 ms INTERRUPT SERVICE
33 ms INTERRUPT SERVICE
RINGER INTERRUPT SERVICE
CALL CONTROL PROGRAMS
CALL CONTROL FOR SUBSCRIBERS/ TRUNKS
ORIG DETECTION
RELEASE DETECTION
RELEASE CONFIRMATION
SERVICE PROGRAMS
DIGIT ANALYSIS & TRANSLATION
DIGIT RECEIVER
DIAL PULSE RECEIVER
DIGIT SENDER
DIAL PULSE SENDRE
ANSWER BACK DETECTION & RINGER CONTROL
ANSWER BACK DETECTION
RINGER CONNECTION CONTROL
METERING PULSE RECEIVER/REPEATER
METERING PULSE RECEIVER/REPEATER
METERING PULSE SENDER
METERING PULSE SENDER
PERIODIC TARIFF GENERATOR CONTROL
PERIODIC TARIFF PULSE GENERATOR
NET WORK HANDLER
LINE SCANNER & DISTRIBUTER
PERIODIC LINE SCANNER
PERIODIC LINE SCANNER
DATA BASE MANAGEMENT PROGRAMS
DATA BASE QUERY HANDLER DEVICE ACCESS PROGS.
EEPROM WRITER READER
ADMINISTRATION PROGRAM
TRAFFIC COLLECT & ANALYSIS
TRAFFIC RECORDING
MAINTENANCE PROGRAM
DIAGNOSTIC PROGRAMS
MAN/MACHINE INTERFACE PROGRAM
FRONT PANEL HANDLER
FRONT PANEL KEYBOARD SCANNER
PRINTER HANDLER
CHARACTER OUTPUTTING

Fig 3b. SOFTWARE ARCHITECTURE


SMALL RURAL AREA
LARGE RURAL AREA
SMALL TOWN
(SINGLE EXCHANGE AREA)
BIG TOWN
(MULTI EXCHANGE AREA)
X1a
X1b
X2
X3
SPL. SER.
TK. OP
X4
X5
OTHER SYSTEM
OTHER SYSTEM
TAX (OTHER SYSTEM)
TK.OP
X6
1/C JN.
X7
O/G JN.
TERMINAL EXCHANGE
TERMINAL EXCHANGE WITH TRANSIT
TERMINAL EXCHANGE WITH TRANSIT AND SPL. SERVICES
: CARRIER JUNCTIONS.

X4 : LOCAL EXCH
X5 : LOC. CUM TANDEM XGE
X6 : TRUNK XGE (SLOD/MLOD) FOR TRK. OPER.
X7 : TRUNK XGE W/- TARIFF GENERATION

FIG 4 APPLICATIONS OF ESAX 200

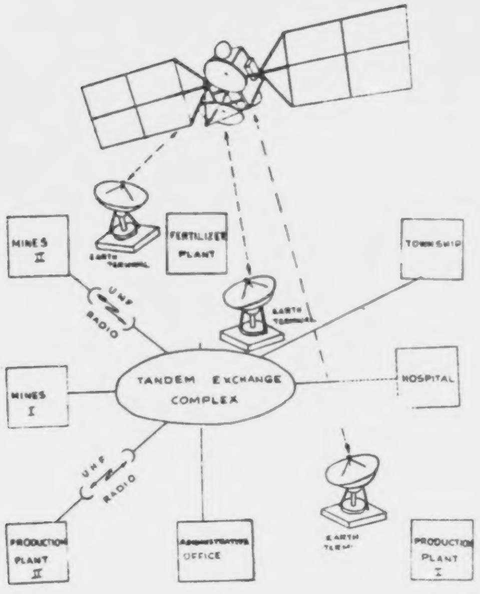

MINES II
EARTH TERMINAL
FERTILIZER PLANT
TOWNSHIP
UHF RADIO
EARTH TERMINAL
MINES I
TANDEM EXCHANGE COMPLEX
HOSPITAL
UHF RADIO
PRODUCTION PLANT II
ADMINISTRATIVE OFFICE
EARTH TERM.
PRODUCTION PLANT I

FIG. 5

PRIVATE COMMUNICATION NETWORK WITH CABLE, RADIO AND SATELLITE LINKS

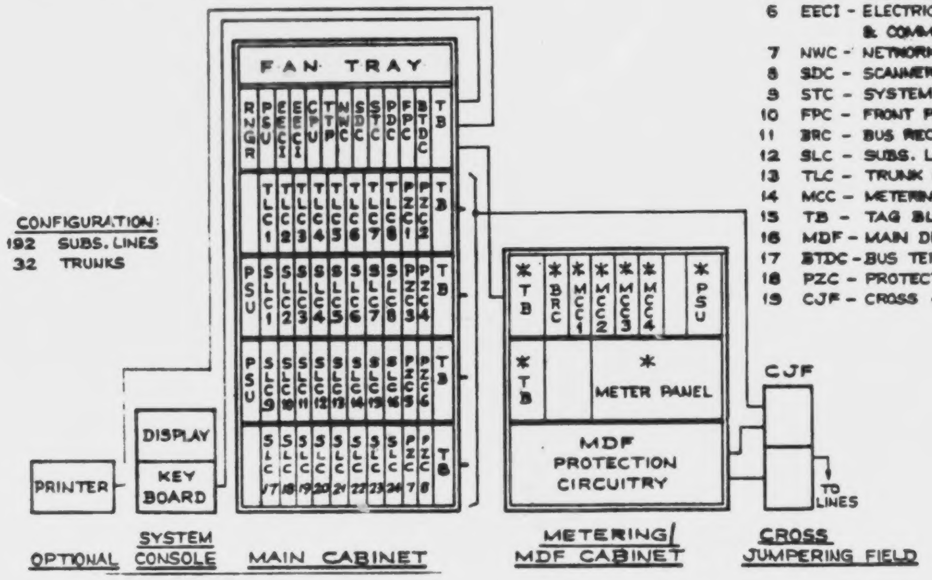
Fig 6. CABINET LAYOUT

NOTES

1 INTER CABINET CABLING IS AS PER DRAWING NO. ESX 000018 XW.
2 JUMPERING ON MDF & CJF IS AS DESIRED BY INSTALLER.
3 EQUIPMENTS MARKED ✱ ARE REQUIRED ONLY IF - HARDWARE MEETING IS USED.

LEGEND

1 PSU - POWER SUPPLY UNIT.
2 RNGR - THREE PHASE RINGER.
3 PDC - POWER DOWN CONTROLLER.
4 TTP - TIMING, TONES & PAGING CCT.
5 CPU - CENTRAL PROCESSING UNIT.
6 EECI - ELECTRICALLY ERASABLE PROM & COMMUN. INTERFACE
7 NWC - NETWORK CONTROLLER.
8 SDC - SCANNER & DISTRIBUTOR CCT.
9 STC - SYSTEM TEST CCT.
10 FPC - FRONT PANEL CONTROLLER.
11 BRC - BUS RECEIVER CCT.
12 SLC - SUBS. LINE CCT.
13 TLC - TRUNK LINE CCT.
14 MCC - METERING CONTROL CCT.
15 TB - TAG BLOCK.
16 MDF - MAIN DISTR. FRAME.
17 BTDC - BUS TERMINATION & DRIVER CCT.
18 PZC - PROTECTION ZENER CCT.
19 CJF - CROSS JUMPERING FIELD


FAN TRAY
RNGR
PSU
EEC
EECI
CPU
TTP
NWC
SDC
STC
PDC
FPC
BTDC
TB
TLC 1
TLC 2
TLC 3
TLC 4
TLC 5
TLC 6
TLC 7
TLC 8
PZC 1
PZC 2
PSU
SLC 1
SLC 2
SLC 3
SLC 4
SLC 5
SLC 6
SLC 7
SLC 8
PZC 3
PZC 4
SLC 9
SLC 10
SLC 11
SLC 12
SLC 13
SLC 14
SLC 15
SLC 16
PZC 5
PZC 6
SLC 17
SLC 18
SLC 19
SLC 20
SLC 21
SLC 22
SLC 23
SLC 24
PZC 7
PZC 8
✱ TB
✱ BRC
✱ MCC 1
✱ MCC 2
✱ MCC 3
✱ MCC 4
✱ PSU
✱ METER PANEL
MDF PROTECTION CIRCUITRY
CJF
TO LINES
DISPLAY
KEY BOARD
PRINTER
OPTIONAL
SYSTEM CONSOLE
MAIN CABINET
METERING/ MDF CABINET
CROSS JUMPERING FIELD

CONFIGURATION:
192 SUBS. LINES
32 TRUNKS

Fig. 6

RURAL TELECOMMUNICATIONS in THAILAND

experiences from a project in progress

Precha Rugsachart
Telephone Organization of Thailand
Bangkok, Thailand

Duncan Sharp
Teleconsult Ltd / Teleconseil Ltee
Vancouver, B.C., Canada

1. Abstract

By the end of 1988, "first time" telephone service will reach over 1,800 villages throughout rural Thailand. Based primarily on time division multiple access (TDMA) subscriber radio systems in the 1.5 GHz band, but including multichannel UHF radios and cable facilities, this large-scale project illustrates the commitment of the Telephone Organization of Thailand (TOT) to providing universal telephone service and to fostering development in the rural sector. This paper provides an insight into the planning and engineering phases of this project. By highlighting some of the key issues, procedures, and decisions, it is the intent of the authors that others who are planning or implementing similar programs may find these experiences both interesting and useful.

2. BACKGROUND

Within its surface area of about 542,000 square kilometres, Thailand embraces a diversity of geographic conditions. The shape of the country has been compared to the head of an elephant. In the north, the elephant's head is crowned by the foothills of the Himalayan range, rising to an average of 1,700 metres. In the south, the trunk extends some 1,000 km down the Malay peninsula. In between, the fertile central plains and Chao Phya River valley, along with the eastern seaboard and south, produce an abundance of rice, sugarcane, tapioca, maize, and tropical fruits.

Approximately 80% of Thailand's 53 million people live in rural areas and almost three-quarters of the remaining 20% live in the Bangkok Metropolitan Area (BMA). Telephone penetration stands at about 7 telephones per 100 people in the BMA and 0.4 per 100 in the provincial areas.

Telephone service is provided nationally by the Telephone Organization of Thailand (TOT). TOT is an autonomous enterprise, wholly owned by the state and organized under the Ministry of Communications. Although service has expanded from about ten thousand telephone subscribers thirty two years ago to about one million today, TOT continues to be challenged by unmet demand in urban areas and low service levels in rural areas.

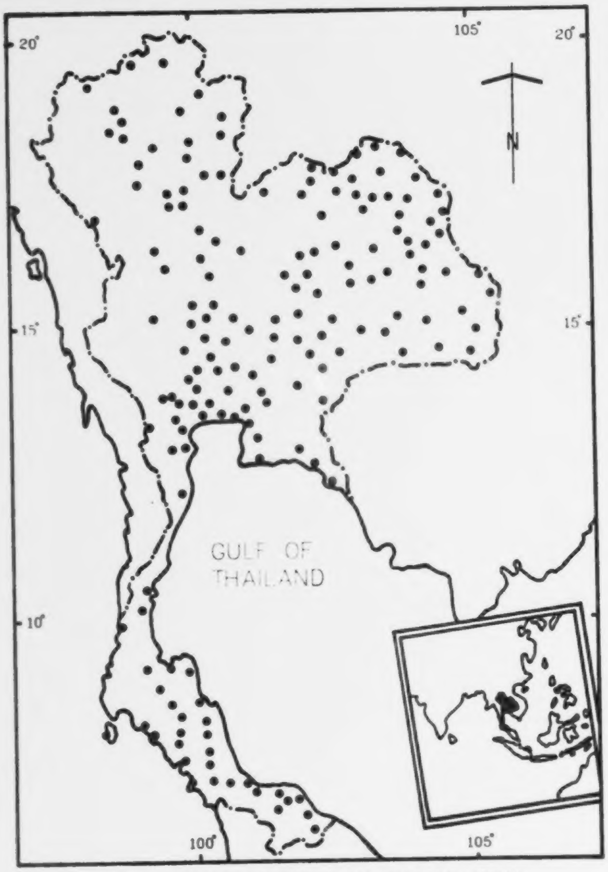


Figure 1 EXCHANGE LOCATIONS FOR RURAL SERVICE EXTENSION (5th ESDP)

The rural component of TOT's previous investment plans extended service to the district, or "amphoe", level. The subject of this paper is the rural component of the current investment plan, known as the 5th Economic and Social Development Plan (5th ESDP). The objective of this plan is extension of service to the subdistrict, or "tambon", level. Figure 1 illustrates the distribution of the local exchanges that will feed the 1,813 tambons served by this project.

This paper is organized to conform with the general sequence of project planning and implementation. Figure 2 outlines this general sequence.

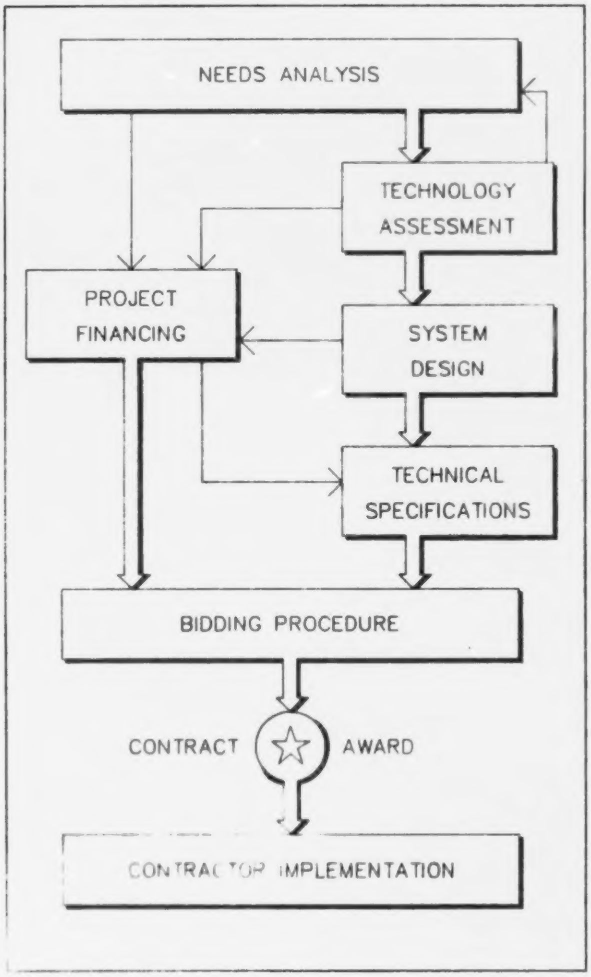


Figure 2 PROJECT SEQUENCE

3. NEEDS ANALYSIS

Surveys to qualify and quantify the need for improved telephone service in Thailand's rural areas began as early as 1980. A study conducted by TOT in cooperation with the East-West Center in Honolulu concluded that access to a telephone in rural Thailand provides a substantial user benefit to cost ratio, significantly improves the quality of rural life, and broadens the benefits of development to include communities that otherwise tend to remain isolated from national development.

Consequently, the 5th ESDP included provision for improving penetration to villages at the tambon level. Currently only about 12% of Thailand's 6,033 tambons have telephone service. The objective of the present project is to raise this penetration to 42%.

Essentially the project will provide facilities to connect subscribers to the nearest existing, or planned, exchange. Voice messages are seen as the dominant use, with telex being a minimal requirement.

The process of selecting service locations spanned more than three years and involved seven man-years of effort by TOT. Basically, selection was predicated on a weighted accounting of population and economic activity factors. In general, the tambons chosen had villages with a higher population (over 5,000 inhabitants) and adequate economic or tourism potential.

An average of three telephone stations per tambon were found to be required initially, with a minimum growth of 100% designed into the initial provisioning. About 60% of the telephone stations should be equipped with a meter for immediate charging of calls, and the remaining 40% should be equipped with coin boxes for subscriber trunk dialing.

Service availability and transmission quality were carefully considered. Quality standards set for urban networks were used as a starting point, and then compromises were made, considering the need to minimize both capital and operating costs.

Service availability is a function of grade of service, equipment availability, and path transmission reliability. If the performance objective for any one of these design parameters is significantly "lower" than the others, then this "low" objective will likely dominate the subscriber's perceived service availability.

The objective for grade of service was set at 1% probability that during the busy hour a call would be blocked or delayed due to a lack of resources in the local network. This objective was set with the recognition that traffic forecasts were based on projections from a very small data base; hence, a need to be conservative.

The equipment availability objective was set at 99.9% for any subscriber, or in other words, a 0.1% probability that any subscriber would be unable to satisfy a call attempt because of equipment malfunction between the telephone set and the local exchange. This objective is consistent with unprotected equipment designs, representing a very significant cost reduction over redundant configurations.

The path reliability and transmission performance objectives chosen for radio systems handling subscriber loop traffic are summarized by Figure 3. These are objectives for a rural subscriber access system and should not, of course, be confused with the national transmission standards set for other networks.

Flexibility was seen as a key requirement of facilities provided for this project. Reasonable expansion capacity should exist; however, if growth greatly exceeds forecasts and justifies more substantial facilities such as a remote switching unit or local exchange, then it should be a simple matter to take the rural equipment out of service and relocate it elsewhere in the network.

RADIO SYSTEM	MAXIMUM ERROR RATE/NOISE	PERCENT OF ANY MONTH
TDMA	10^{-7} BER	1.0%
	10^{-3} BER	0.05%
UHF	2,500 pWOp	50%
	10^{6} pW	0.1%

Figure 3 TRANSMISSION PERFORMANCE OBJECTIVES

4. TECHNOLOGY ASSESSMENT

An assessment of available technologies was made to determine those best adapted to the defined need. A comprehensive technical feasibility study was undertaken in 1983 with the assistance of the Japan International Cooperation Agency (JICA).

The distribution of villages, the terrain, and the need for flexibility suggested a type of multiple access radio system supplemented as necessary with multichannel point to point radio and cable.

Multiple access subscriber radio systems can be based on time division (TDMA) or frequency division (FDMA). Although TOT has some experience with FDMA subscriber radio, TDMA has also been well developed for this application, with systems in service in many countries around the world. The importance of a field-proven technology was recognized for this remote, and large scale, application.

With TDMA, all subscribers at each remote location share the total channel resource (typically 15 time slots or voice channels per radio frequency pair) using a single transceiver per site (see Figure 4). With FDMA, the exchange location must be provided with multiple transceivers (one for each voice channel required) and at villages with multiple telephones more than one transceiver will often be necessary to provide an adequate grade of service. Since in Thailand's case the average village would require three telephones initially and considerably more in future, TDMA provided the best value in terms of cost, performance, and flexibility.

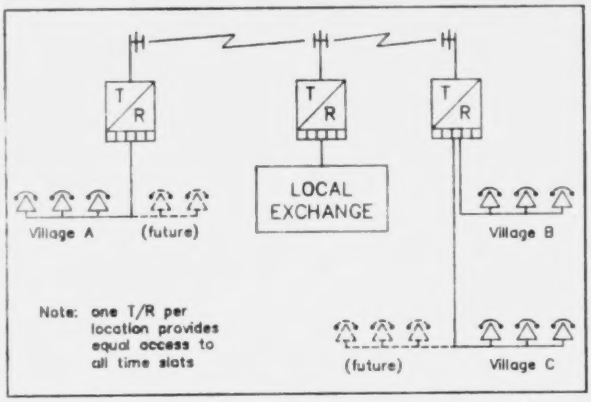

T
R
T
R
T
R
LOCAL EXCHANGE
Village A
(future)
Village B
Note: one T/R per location provides equal access to all time slots
(future)
Village C

Figure 4 TDMA SUBSCRIBER RADIO SYSTEM

Sufficient spectrum was available in the 1.5 GHz band for a nationwide system to be implemented in a cellular, frequency reuse arrangement.

The digital versus analog controversy was first addressed during this phase of the project, and it continued as a lively debating point with manufacturers as well as experts from the funding agencies. However, as the facility is simply an extension of the subscriber loop and principally intended for basic telephone voice service, TOT engineers maintained that either analog or digital transmission would be acceptable throughout the anticipated design life of the equipment.

5. PROJECT FINANCING

The nature of the rural project allowed it to be conveniently decoupled from the main ESDP, of which it formed a part. Agreements to co-finance the project were reached with the Asian Development Bank (ADB) and Japan's Overseas Economic Cooperation Fund (OECF).

OECF agreed to finance service to some 283 tambons, and ADB agreed to finance the remaining 1,530 tambons in the project. This financing covered only the link between the telephone exchange and the subscriber distribution point. The subscriber stations and the drop wire installation have been funded separately.

Although OECF generally elected to fund tambons in the north and northeast provinces, service areas under the funding of each agency were interspersed with those of the other. This created a potential complication. If a qualified bidder was eligible under one funding agency's guidelines, but not the other's, then two contracts would theoretically have to be let to potentially different equipment vendors. Had this happened, frequency coordination, training, staffing, and sparing complications could have been significant.

Fortunately TOT preference for a single supplier prevailed and this potential complication was left behind.

Procurement guidelines from both funding agencies had to be followed. Figure 5 shows the principal review and approval points for the project.

In addition to these review and approval points, other conditions were included in the loan agreements with the funding agencies. These included regular progress reporting, appointment of a qualified full-time project manager, training requirements, and prequalification of bidders.

Although the funding agencies required that the number and location of tambons to be served remain relatively fixed, some flexibility was permitted to allow changes based on the results of the detailed engineering phase.

- SYSTEM DESIGN REVIEW
- PREQUALIFICATION INVITATION
- PREQUALIFICATION EVALUATION
- DRAFT INVITATION TO BID
- TECHNICAL PROPOSAL EVALUATION
- PRICE PROPOSAL EVALUATION

Figure 5 FUNDING AGENCY REVIEW & APPROVAL POINTS

6. SYSTEM DESIGN

The considerable engineering effort required to develop system designs for each exchange area was undertaken in-house by TOT engineers in the Long Distance Plant Engineering Division.

Based on map surveys and path profiles, route plans were laid out to serve the 1,813 villages from some 243 existing local exchanges. The route plans considered the following factors:

(a) location of existing exchanges,
(b) the numbering plan,
(c) location of existing transmission facilities,
(d) the 10 year master plan, and
(e) service quality objectives.

Of the total 1,813 tambons, 1,620 could be served using TDMA subscriber radio, 141 by multichannel UHF subscriber radio, and 52 by cable. The resulting equipment quantities are summarized in Figure 6. In general, TDMA was used unless the number of tambons served by radio from a given exchange was less than four, or if propagation at 1.5 GHz would not be satisfactory (for example, long or obstructed paths).

DESCRIPTION		QUANTITY	UNITS
TDMA	Central Stations	158	Each
	Drop Repeaters	115	Each
	Thru Repeaters	62	Each
	Remote Stations	1,505	Each
UHF	Exchange/Remote Terminals	141	Pair
CABLE	(Excluding Subscriber Drop)	137	Km

Figure 6 PROJECT EQUIPMENT LIST

Because the project was distributed country wide, spectrum requirements were also addressed at this stage. A request for a block assignment of spectrum in the 1.5 GHz band was approved by the ministerial department responsible for frequency management. To facilitate frequency reuse, a maximum path clearance criterion of 40% of the first Fresnel zone was applied when calculating antenna heights.

System designs, including route layout, path profiles and transmission calculations were prepared for over 1,800 radio paths. Even with a computer program to assist with calculations, this represented an immense task. The effort spanned a time frame of about one year and involved twelve engineers.

7. TECHNICAL SPECIFICATIONS

The system design was translated into technical requirements and equipment specifications suitable for international competitive bidding. A telecommunications consulting engineering firm, Teleconsult Ltd / Teleconseil Ltee from Canada, was retained to assist with this phase, as well as the bid evaluation phase.

To ensure full contractor responsibility for performance, the specifications were based on an engineer, furnish, and install contract. The scope of work included all equipment, labor, and services required to provide a complete and fully operational rural network. Services were broken up into tasks including design responsibility, site engineering, provision of documentation, installation, testing, maintenance and technical support, and training.

Figure 7 outlines the general structure of the three volumes that made up the technical specifications for the project.

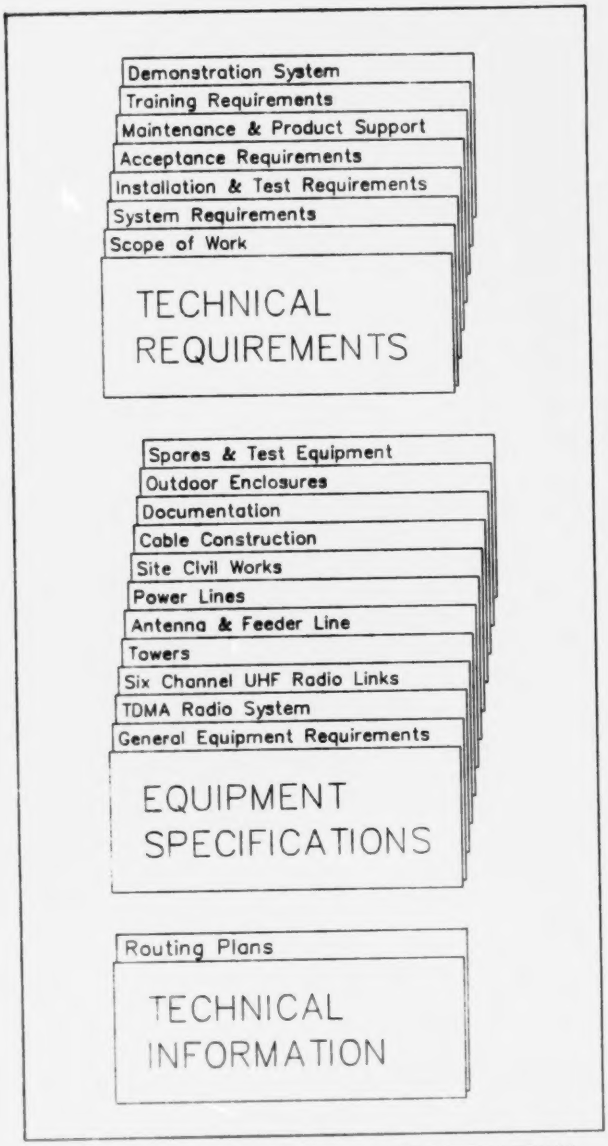

Demonstration System
Training Requirements
Maintenance & Product Support
Acceptance Requirements
Installation & Test Requirements
System Requirements
Scope of Work
TECHNICAL REQUIREMENTS
Spares & Test Equipment
Outdoor Enclosures
Documentation
Cable Construction
Site Civil Works
Power Lines
Antenna & Feeder Line
Towers
Six Channel UHF Radio Links
TDMA Radio System
General Equipment Requirements
EQUIPMENT SPECIFICATIONS
Routing Plans
TECHNICAL INFORMATION

Figure 7 TECHNICAL SPECIFICATION OUTLINE

In the preparation of specifications, care was taken to ensure that competition was maximized without compromising the essential needs of the project. The minimum requirements were crafted to accommodate TDMA systems with different numbers of time slots, feature sets, and line capacities. Suppliers of equipment with different technical characteristics were given the opportunity to propose configurations that met the basic service objectives.

In view of the fact that proposals will later be evaluated against these minimum acceptable requirements, it is important that the specifications clearly differentiate between mandatory and desirable requirements.

The ability of a contractor to adequately implement a frequency plan for his TDMA equipment offering was seen as a critical evaluation issue. Thus, the specifications included a requirement that bidders, in their technical proposals, demonstrate on paper how frequencies could be successfully coordinated in the most congested area, as well as how the basic plan could be extended to cover the whole country. The plan also required spare frequencies for future expansion (and to clear interference cases).

All equipment interfaces were defined and detailed in the specifications. These included the various exchange and telephone station line interfaces, with attention to metering signals and timing requirements. AC and DC power to be made available to the equipment was also characterized.

Equipment protection was not specified as a requirement, as the availability objectives were tailored to accommodate unprotected configurations. However, equipment reliability in terms of a minimum Mean Time Between Failure (MTBF) was specified. To permit the future upgrade of systems, it was a requirement that redundant configurations could be easily implemented to the unprotected systems initially provided.

Battery backup is available at exchange locations and some repeater sites. All other locations will be operated from commercial AC power with the requirement that future battery backup can be easily accommodated. A few sites will be powered from solar plants.

The contractor's scope of work includes provision of a demonstration system in advance of the first large scale equipment deliveries. The demonstration system includes installation and testing of TDMA and multichannel UHF radio links associated with a selected exchange area. The purpose of this demonstration is to verify the adequacy of equipment and methods and to ensure concordance between the contractor and TOT with respect to performance and procedures. The intent is to eliminate any difficulties with either the equipment or the procedures before large scale implementation begins. Testing of the demonstration system includes some supplemental tests (such as propagation monitoring) that will not be required on the other systems.

8. BIDDING PROCEDURES

The bidding procedures were shaped by the procurement guidelines issued by the funding agencies (ADB and OECF) for international competitive bidding.

Bidders were prequalified to ensure that only technically and financially capable suppliers offering field-proven TDMA subscriber radio products were allowed to participate. Screening out unqualified bidders at an early stage avoided unnecessary effort and expenditures on the part of prospective bidders and TOT. A clear definition of the qualification requirements is essential to make this phase efficient and easy to implement.

Of the seventeen firms submitting prequalification documentation, nine were qualified to participate in this particular project.

The actual bidding procedure was conducted in two stages: one, submission and review of technical proposals; and two, submission of price proposals. The procedure is outlined in Figure 8. Two stage bidding has the advantage of maximizing competition and facilitating bid evaluation in large and complex contracts where there is a potential for receiving technically unequal bids.

Of the nine prequalified firms, seven submitted technical proposals. After evaluations, bidder meetings, and the submission of revised technical proposals, all seven bidders were deemed to meet the minimum acceptable requirements, and were requested to submit price proposals. It should be noted that every supplier of field-proven TDMA subscriber radio was represented in these seven bids.

After evaluation, adjustment, and comparison of the price proposals, contract negotiations were entered into with the lowest bidder.

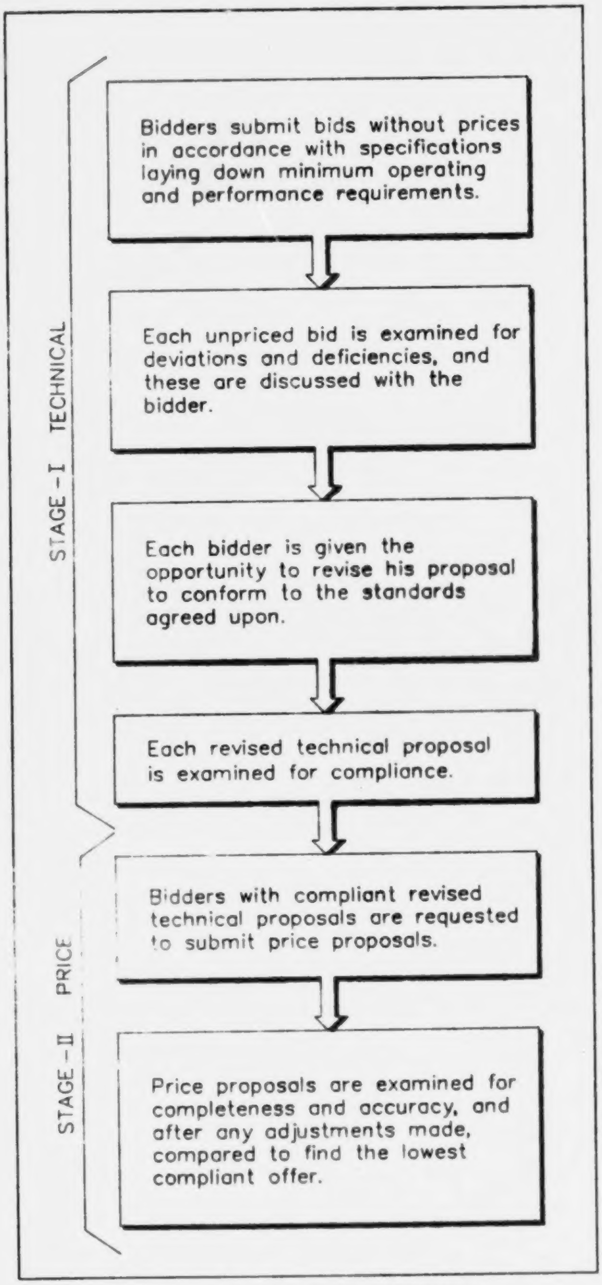

STAGE - I TECHNICAL
Bidders submit bids without prices in accordance with specifications laying down minimum operating and performance requirements.
Each unpriced bid is examined for deviations and deficiencies, and these are discussed with the bidder.
Each bidder is given the opportunity to revise his proposal to conform to the standards agreed upon.
Each revised technical proposal is examined for compliance.
STAGE - II PRICE
Bidders with compliant revised technical proposals are requested to submit price proposals.
Price proposals are examined for completeness and accuracy, and after any adjustments made, compared to find the lowest compliant offer.

Figure 8 TWO STAGE BIDDING PROCEDURE

9. CONCLUSION

At the time of writing this paper, TOT is in contract negotiations with Mitsui & Company of Japan. The TDMA equipment offered by Mitsui is manufactured by NEC. It is a technically advanced product featuring 15 message time slots, 1 MHz channel spacing, adaptive differential PCM encoding (32 kb/s voice channel rate), and a comprehensive feature set.

In concluding this paper we wish to summarize the four key aspects that we feel contributed most significantly to the present success of the project.

(a) The strong and high level of commitment to rural service exhibited by TOT.

(b) The extensive and detailed planning undertaken by TOT to fully define the rural need and to mobilize the resources necessary to engineer and implement the project.

(c) The high standard of engineering study, the detailed system design, and the continuity provided by the project team in TOT's Long Distance Plant Engineering Division.

(d) The value of international competitive bidding to secure high quality products at low cost.

This project is an important contribution to rural development. Its continued success will ensure and expedite the additional projects necessary to fully realize the provision of universal telephone service in Thailand.

ACKNOWLEDGEMENTS

This project has demonstrated the commitment of ADB and OECF to telecommunications development in the rural sector. Their initiative, and continuing assistance, is gratefully acknowledged.

All technical proposals submitted by bidders for this project were of a high standard, with highly competitive pricing. It is regrettable that the contest could only have one winner. The efforts of those that did not succeed in this bid are recognized and appreciated.

AUSSAT - SATELLITE SERVICES IN AUSTRALIA

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AUSSAT Pty Ltd
Sydney, Australia

ABSTRACT

The first generation AUSSAT satellite system has now been operational since the end of 1985, providing a range of conventional and innovative satellite services to the whole of Australia. This paper outlines the types of satellite service which are being offered by AUSSAT or are planned to be offered, together with, the supporting research and development activities being undertaken.

1 INTRODUCTION

The AUSSAT system presently consists of two satellites in orbit at 156 and 160°E longtitude. The third and final satellite in the first generation is due to be launched in March 1987 aboard Ariane V19, and will be located at 164°E. The ground communications component of the system consists of numerous earth stations ranging from the large 13-18 metre AUSSAT owned Major City Earth Stations, which provide multipurpose transmission facilities for satellite Television, Radio, Data and Voice to the small 1.2 to 1.8 metre TVRO earth stations which receive DBS television and radio services that are provided across the country through special high power transponders on each satellite.

2 SERVICES

2.1 BROADCASTING

Television and radio broadcasting, and program exchange, constitutes the bulk of the capacity utilised in the AUSSAT system.

(i) Homestead and Community Broadcast Satellite Service (HACBSS)

The Homestead and Community Broadcast Satellite Service plays a dual role. It serves as a direct-to-home television and radio service as well as a program relay service to regional transmitters for terrestrial rebroadcasting at either VHF or UHF. HACBSS utilises the B-MAC format to provide a video signal with stereo sound, two mono and one stereo radio programs and an auxiliary 9.6 kbps broadcast data channel.

The direct to home broadcasting requires the use of 1.5m TVROs.

These achieve a clear sky C/N of nominally 15 dB which provides around a 6 dB fade margin to the B-MAC service threshold, and a further 5-6 dB margin to total signal loss. The program relay utilises 3.7m, 4.6m and 6.5m antennas (the size being dependent on satellite power and climatic conditions) and are designed to provide a signal to noise ratio of greater than 38 dB unweighted for 99.9% of any month.

This service has been in operation for over one year and provides the Australian Broadcasting Corporation (ABC) with a total nationwide coverage.

(ii) Remote Commercial Television Service, (RCTS)

The RCTS is a commercial television parallel to the HACBSS. As each AUSSAT satellites system can provide two high power transponders to any one of the four spot beams, these are utilised to provide one national, ABC, and one commercial service. The format of the RCTS is identical to that of HACBSS.

(iii) Television and Radio Program Distribution and Compilation

As well as broadcasting the AUSSAT system is also being utilised to provide for a range of program compilation and distribution services.

The ABC is utilising two transponders for high quality television program exchange between the capital cities. This service uses a frequency modulated PAL signal and operates between 13m and 18m antennas.

The ABC is also using a transponder operating in a multicarrier mode for sound program (15 kHz) exchange among its many radio studios (both capital city and regional).

The Special Broadcasting Service, SBS, is utilising a low power spot beam to distribute television to the capital cities and major regional centres.

The major commercial television and radio networks are also providing satellite based program distribution to capital city and regional centres (Satellite Program Service, SPS) as well as live program and news feeds.

(iv) Video & Audio Entertainment Industry Services, VAEIS

The satellite has spawned the introduction of a number of closed circuit entertainment services. These services utilise the B-MAC video format, operating in a scrambled and addressable mode, to provide video entertainment (sports, racing, live shows, etc) to a number of closed user groups. Services to a national hotel chain and to the New South Wales Registered Clubs are currently operating.

Table 1 summarises the formats and operating parameters of the television services currently operating on the AUSSAT satellites(1).

2.2 GOVERNMENT

A number of government organisations are using the satellite for a new range of services:

(i) TELECOM, Iterra Business Service (IBS)

TELECOM AUSTRALIA is using the satellite to provide for remote voice and data services, business services, and capital city services. The IBS uses a demand assigned FDMA network based on a major control and switching station at Bendigo. Two Mbps data services are being provided by dedicated QPSK carriers.

(ii) Department of Aviation (DOA)

The DOA has established an Australia-wide grid of sites (101 sites with 202 earth stations) to provide for a complete air traffic and safety communications network. Aircraft communicate to the ground stations via conventional VHF techniques and then via satellite to a central control centre. The system is fully redundant utilising four transponders on two satellites operating in an FDMA voice mode.

(iii) Queensland Government (Q-NET)

The Queensland Governement has established a state-wide satellite communications network to provide for education, medical services and administrative requirements. A pilot satellite School of the Air (SOTA) service based at the remote mining community of Mount Isa links ten homesteads with two-way voice and data communications to Mount Isa. A video signal is also broadcast from Brisbane as part of the education service.

Q-NET also provides voice and data communications using an SCPC system and has introduced a pilot Very Small Aperture Terminal (VSAT) network utilising spread spectrum techniques to communicate from 1.2 x 1.8m elliptical antennas to a hub station in Brisbane.

2.3 AUSSAT SERVICES

AUSSAT Pty Ltd, the owner and operator of the AUSSAT system, also provides a range of ground segment services. These inlcude television, radio, voice and data uplinks and downlinks from its MCESs and the soon to be implemented STAR NETWORK SERVICE.

The STAR NETWORK is a VSAT based data network that is to operate from three hubs,

USER	FORMAT	BANDWIDTH	DEVIATION (PEAK TO PEAK)
HACBSS	B-MAC	24 MHz	16.5 MHz
RCTS	B-MAC	24 MHz	16.5 MHz
SBS	B-MAC	36 MHz	28.5 MHz
TV Interchange	PAL	40 MHz	30.0 MHz
Commercial SPS	Encrypted PAL	30 MHz	22.0 MHz
VAEIS	B-MAC	24-36 MHz	16.5-28.5 MHz
Education (Q-NET)	B-MAC	24 MHz	16.5 MHz

TABLE 1: AUSSAT VIDEO FORMATS

Sydney, Melbourne and Canberra, with all network control and monitoring being carried out from Sydney. The service will be introduced in Sydney in April. The likely customer base includes the financial industry, the retail industry, governement services, document transfer, the service industry, etc. Market projections indicate a total of 1000 VSATs installed and operational within three years, with an annual growth of up to 500 VSATs for several years after.

2.4 NEW ZEALAND

AUSSAT-3, due to be launched in March 1987, has the same Australian wide coverage as AUSSAT-1 and AUSSAT-2, but provides also a South West Pacific Beam. This beam covers New Zealand.

The New Zealand Post Office proposes to implement a pilot satellite video service as well as to provide for remote domestic communications using the AUSSAT-3 satellite. Chatham Island to the east of New Zealand, is one of the prime candidates for the satellite service.

Table 2 summarises the current and future useage of the AUSSAT first generation satellites.

3 RESEARCH AND DEVELOPMENT

3.1 RAIN MEASUREMENT PROGRAMS

The AUSSAT system operates at Ku band and it represents the first use of this frequency band for satellite communications in Australia and one of the first uses of Ku band for satellite services in tropical regions.

A number of research programs have been initiated to investigate the effects of heavy rainfall, both in tropical and temperate regions, on the propagation of satellite signals at Ku band. AUSSAT has beacon level and radiometer measurement programs in operation at each of the MCESs. The data collected so far has been compared with predictions based on long-term rain rate statistics and assumed the attenuation models.

AUSSAT is also collecting rain rate data and using TVROs to measure downlink attenuation to give information on the nature of local rainfall. This is being persued to gain an insight into the possible use of site diversity to improve overall system availability, should the prove necessary.

AUSSAT has also entered into a number of joint study programs:

	TRANSPONDER USEAGE			
SERVICE	CURRENT		END 1988	
	12 W	30 W	12 W	30 W
HACBSS	1	4	1	4
RCTS	-	1	-	4
TV Interchange & Distribution	6	1	7	-
VAEIS (TV)	1	2	3	3
Government	6	-	8	-
Radio	1.2	-	2.0	-
Corporate	1.0	-	3.0	-
Offshore (NZ)	-	-	0.5	1
TOTAL	16.2	8	24.5	12
Available	22.0	8	33.0	12
SPARE	5.8	0	8.5	0

TABLE 2: AUSSAT USEAGE

(i) A dual frequency radiometers (Ku Band and C Band) to be located in Suva, Fiji, which is part of a joint AUSSAT/ South Pacific Telecommunications Development Programme project.

(ii) A beacon receiver and Ku Band radiometer to be loaned to TELECOM to further enhance their inhouse rain attenuation studies.

(iii) A Ku Band radiometer to be loaned to University of James Cook in Queensland. University of James Cook already have a number of rain studies in progress, particularly at C Band, and this project is considered of value as the region is the wettest area in Australia.

3.2 OTHER

AUSSAT has a number of other Research & Development projects under way including:

- a formal program with Australia's Commonwealth Scientific & Industrial Research Organisation, CSIRO, investigating multiple feed antennas
- informal contact with a number of tertiary institutions with the aim of developing low speed data gathering earth stations.

4 SECOND GENERATION

The planning for AUSSAT's second generation system is well advanced. AUSSAT has undertaken discussions with its major current satellite users and with potential future users. These discussions have been used to tailor the possible concepts and applications for the second generation satellites including:(2)

- the use of higher capacity satellites. The second generation will utilise more efficient filtering to increase the total useable bandwidth as well as providing greater power capacity than the current system.
- tailored beams to meet specific customer demands including, weighted national beams and dedicated New Zealand beam.
- a mobile package (most likely at L Band).
- other special facilities (eg defence X Band capacity, remote data collection facilities, retroflectors for precision time transfer and laser ranging, propagation beacons at VHF/UHF/L Band at Ka Band).

AUSSAT has also been in discussion with prospective satellite suppliers in order to refine the system concepts.

All the work is presently on schedule to meet the following timetable:

- RFT Issue	July 1987
- Contract	July 1988
- Date in service	1991/1992

5 CONCLUSIONS

An overview of the current uses and loading of the AUSSAT satellite system has been presented. The satellite system is providing for conventional communications needs (eg television distribution) as well as a number of new and innovative uses such as HACBSS, the SOTA trial and the Department of Aviation network.

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SESSION 3
Educational Uses

USPNET Satellite Development: An Educational Model from the South Pacific A Personal View from Within

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Abstract

New developments in satellite education at the University of the South Pacific demonstrates new potential in instructional university education which will be of great significance for the Pacific Basin.

Summary

The University of the South Pacific serves the eleven island nations: Cook Islands, Fiji, Kiribati, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Western Samoa. Negotiations are in progress for the Federated States of Micronesia and Marshall Islands to join as member states of our regional University. Although the extension is welcomed by our University Council because USP is obliged to respond positively to the needs of Pacific peoples, it will compound our communication problems.

The University of the South Pacific serves the region's needs for tertiary education through two campuses and a series of Schools, Institutes, Extension Centres and Units. The main Laucala Campus is located in Fiji. This is the base of USPNET which is administered by Extension Services for University activities which need access to other countries of the region.

Undergraduates teaching and an increasingly important programme of post-graduate work are based mainly at the Laucala Campus while agriculture students attend the Alafua Campus in Western Samoa. Teaching, consultancy, and research are conducted in all member countries. For example, ten countries have Extension centres which represent the University in that country.

There is a Pacific Language Unit and a Pacific Law Unit based in Vanuatu, an Institute of Rural Development in Toga, an Institute for Research, Extension and Training in Agriculture in Western Samoa, and Atoll Research Unit in Kiribati; the Insititutes which focus on Social and Administrative Studies, Pacific Studies, Education, Natural and Marine Resources are based at the Laucala Campus. New units which carry out research into energy and ocean management have also been set up recently. All have projects in varioius countries. All can have access to USPNET and will in the near in variou countries. All can have future benefit when we have full data transmissions facilities by computer and facsimile via satellite. The variety of activities of the diverse sections of the University are no less complex or interesting than the variety and diversity of students and staff who attend and work in the institution giving it a character which is unique in the world. More that 10,000 students are involved with USP in one way or another each year. Of these about 200 full time students are enrolled in the undergraduate programme at the two campuses in 1986.

Over 3000 more students are spread out in the eleven countries of the region who study part time for certificates, diplomas and degrees. Inquiries also come from other parts of the world requesting opportunities to study with USP through the distance education programme. Because of communication problems, it has not been possible to accommodate many of these requests. Communications is a key factor therefore in the success of this kind of programme where we have more students off-campus than on. The above refer to the students who have been studying for credits but we also have over 5,000 more students enrolled in short courses, continuing education programmes and other specialised programmes. The vast expanse of sea in which our countries are located truly epitomises the saying "the tyranny of distance" but we are rapidly learning not only to manage it but to overcome it.

The University of the South Pacific has long since recognized the need for a more effective and affordable communications system for the activities outlined above. Not only because our students are so spread out and there are disadvantages studying at a distance, but also because governments have come to appreciate that learning at a distance is nevertheless a more cost-effective method of providing higher education for their peoples compared to the more traditional way which requires going away overseas to attend courses at Universities for three or four years. Distance education allows students to both work and study in their home countries but with successful students being given the opportunity to spend shorter time to complete their studies overseas.

Previous PTC conferences have had papers delivered by researchers and commentators on USPNET's use of NASA's ATS1 satellite as part of the PEACESAT experiment of 1972-1985. It is time to focus on the more recent developments of USPNET now that it has been reactivated through the uses of Intelsat V and how we visualise its future development. There will be follow-up research on our use of the new system in 1987 which will be referred to PTC. Intermittently before the demise of ATS1 and subsequently before the present Intelsat solution to USP's communications needs, it was fashionable for some telecommunications administrators in the region to claim that the USP was not in a hurry to get into a more long term and effective system for its distance education programme. They assumed that because ATS1 was free therefore the USP was dragging its feet to remain on a free system. The truth is more mundane. The users of ATS1 would know that the quality deteriorated well before its demise in 1985; a large number of people worked hard at USP and elsewhere to find an alternative, and today there are members of PEACESAT who are still looking for another spare satellite channel. If it is provided free it is their good luck. The PEACESAT network has proven its usefulness to the Pacific peoples. It deserves to continue what it started as a community service.

In 1982 the USP requested Fintel (Fiji) for a costing to access Intelsat. They proposed a $352,000 annual charge. The University did not have the money to pay such a ridiculously unrealistic price. Futhermore, in 1983, the University's financial situation was exacerbated when there were cuts to its budget.

The climate of opinion in 1983 was hardly right to negotiate with Fintel for a more realistic telecommunications charge. The University's non-reaction was sensible when it is considered that part of the funding for the USP comes from the eleven countries which own it, most of which have per capita income below US$500 per year. In view of the dramatic changes in the attitude of international carries towards the use of telecommunications facilities for other categories of "specialised" needs, such as education and health, rather than simply be providers of telephone and other traditional services, deregulation and other new developments have worked to the advantage of USP in the region. In other words, it was worth waiting for the "affordable" service we now have via Intelsat.

Although the administrators of the University's budget were unable to provide the money in 1982-83, it did not stop some of us from continuing to seek alternatives to AST1. We did not simply sit down and hope for a miracle to happen. An USAID team evaluated its assistance to the University's Communication Project in 1984 and made recommendations. USAID had spent over two million dollars US for the ATS1 project. It was interested in the new alternative. Their help is acknowledged for that project and for the new one on Intelsat for providing funds for upgrading the equipment in our Centres. PEACESAT consortium held a seminar. We consulted as many people as we could in regional Posts and Telecommunications Departments, SPEC, etc.

The year 1984 was the watershed for the USPNET Communications project. The South Pacific Telecommunications Development Project had been established in Suva next door to the University at the headquarters of the South Pacific Bureau for Economic Co-Operation (SPEC). SPEC, a sister regional institution, is the secretariat for the Heads of Governments meeting, the FORUM. The decision was made by the Forum leaders to lodge USP's telecommunications needs in the SPTDP programme.

The Vice Chancellor of USP, in his request for access to SPTDP in 1984, had indicated that it would seen senseless for USP to go it alone. For many small island states such as the member states of USP, as well as SPEC, it is necessary and more cost-effective to pool resources and efforts as a region in the development of telecommunications or any other activities for the South Pacific. Acceptance into the South Pacific Telecommunications Development Project in 1984 allowed USP to have observer status in the SPECTELs meeting of P&T administrators of the region. Their sympathetic attitude to solving USP's communications needs for a better telecommunications system is appreciated. Some would not have charged for installing telephone lines into our Centres for the Intelsat Project but were discouraged particularly by Fiji. The reason some gave for wanting to provide this service free was that USP provides initial basic training for their staff, and they also have free access to our Centre facilities for workshops and meetings.

In the June 1986 meeting of the Management Group of SPTDP, it was agreed that USPNET should gain access to Intelsat. The annual tariff and other charges were made public for the first time. The University felt they were "affordable". Fintel (Fiji) co-ordinated the linking activities for six countries that have earth stations, i.e. Cook Islands, Fiji, Kiribati, Solomon Islands, Tonga, and Vanuatu. Western Samoa was unable to gain access immediately.

It aims to do so in 1987. Niue and Tuvalu will allow USP to install HF equipment to enable them to patch into the USP studio in Suva in 1987. Presumabley, this will be a temporary arrangement. As smaller and cheaper earth stations are being developed, it is not unrealistic to assume the eventual replacement of HF equipment.

The date for access to Intelsat was 1 September. We had been out of audio communication with our staff in the region since August 1985. The excitement of linking up again by voice was dramatic. Our Working Group became active. The Group held meetings regularly up to the planned date of success. Our activities increased. Tutors started to phone up about when they could start again to teach their students by satellite.
Examinations were looming up in November. Revision of courses were popular. Workshops were organised for operators and tutors as part of the planning which had been going on throughout the year. Staff who were new to the system were invited to attend,as were thise who had experience with the use of satellite.

As would be expected with installing anything new and region-wide, there were technical as well as communication problems. Landlines connecting our Extension Centres could not be installed immediately at the various locations. It took almost a week before all six countries which have earth stations could link up and communicate fully with each other. Nevertheless the reactivation system provided a great deal of excitement even if voice only was available. Being able to communicate with our staff in the six University Centres was a highlight of the year's distance education and other programmes that we offer through Extension Services.

Rental Charges

USP accepted the Intelsat Service because it considered the new charges to be "affordable". Further, the offer by Intelsat to provide free use of the space segment through Project SHARE (Satellite for Health and Rural Education) for the period 1 September 1986 to 30 September 1987 is an additional incentive. The total annual cost for six active locations is just under US$18,000. USP will pay quarterly instalments to Fintel from 1 September 1986. These charges will be revised when other Centres join the network, or when New Zealand begins to charge relaying costs for the Cook Islands sector. After a year of free service through Project SHARE, unless we can get the period extended, we will have to pay for the space segment.

Electronic Information Exchange

The University is an enormous resource base. Shifting of information over our vast scattered region is slow and inefficient for the nineteen eighties, which is witnessing the information age revolution. We hope to improve our operations when the appropriate equipment for rapid transfer of data and text files are installed in 1987. Each satellite terminal in the Centres and Alafua Campus will have an IBM Computer including MicroVax terminals at Extension Services and the computer linked into other sections e.g. Academic Office for students records services. Ten hours at night and some of the day time hours of the 24 hours satellite channel available will be used to automatically transfer data. This will improve our services to the region in a way unimaginable previously.

The University's Extension Services operate a weekly courier mailbag delivery service by air from the Laucala Campus in Suva to its ten University Centres. On average about 300 pieces of print mail are distributed regionally each week. It is not always a satisfactory operation. Aircraft services to most of our island states are erratic.

Mailbags get offloaded or go astray. All these take time to sort out. It is particularly difficult during the examinations period at the end of a semester when something goes wrong with delivery of examination papers.

It is proposed to establish a facsimile machine in each Centre and linked to the two campuses. Some documents could be exchanged by satellite rather than the present mailbag system, thus increasing efficiency of our operations. More efficient management of the distance education program is envisaged for activities of Extension Services such as dispersal of teaching materials, enrollments statisitics, examination results research data, texts and other printed material which will eliminate human errors that occur during audio transmission. It will be useful also for tutors. Tutors could send queries to students and vice versa before the class discussion. Graphics material can be used for teaching. Much time will be saved and utilised for teaching.

Users

User satisfaction since access to Intelsat has been ascertained, two months after USP Net became operational. We organised a seminar with tutors who have used the system to evaluate their use of the system. One who had used the old AST1 during the last few weeks before its demise in August 1985, described the experience as amazingly clear and a pleasure to use.

Where Do We Go From Here

USP is the world's largest user of satellite for international university education. That may be the direction of university education in the future. Universities naturally began as a parochial service, then became more provincial, then national. After World War II there was a great increase in students from various countries attending national universities in other countries.

In 1946, the University of the West Indies was established as the first multi-national university. Several others (e.g. University of East Africa, and University of Losotho, Botswana, etc.), began but soon failed, owing to political problems.

But satellites and internationalism bring us now to the threshhold of a new era in university education. I am currently a member of a Commonwealth Expert Group which is drafting plans for greater co-operation in university distance education between the 46 nations of the Commonwealth. For a student in Tonga to take a specialised course from the University of the West Indies, or from the University of London or the University of Saons, Malaysai, as a credit towards a degree in our university may soor be feasible. Likewise, it should be possible for students in Zambia or Australia or Jamaica who have special interests in the Pacific, to integrate some of our courses with their degree progrmmes in their home university.

At the same time, we are having discussions with colleagues in Japan and hope to being experimental two-way distance teaching between Japan and the South Pacific in the future. These projections into the future will be discussed with telecommunications administrators and international carriers. These are only a beginning. Telecommunications is likely to revolutionise the whole concept of university and other levels of education in the world. For the Pacific Basin particularly, it offers a rich potential and national chauvinism, enabling us all to both give and gain from each other. It is encouraging that the Pacific Islands are world leaders in this field. We hope to keep it that way!

Open Learning Systems
Through Telecommunications

Dr. Glen Farrell, President, and Ms. Lucille Pacey, Executive Director
Knowledge Network of the West Communications

1. Abstract

The last two decades have seen the concept of lifelong learning evolve as a fundamental need in our society. With that has developed an increased demand for access to educational opportunities and for training and retraining of the workforce to accommodate change which is largely driven by the development of new technologies. This paper begins with an overview of that evolution through the discussion of a model which describes how, through the use of new communications technology, the educational system has responded to meet these changing needs. Moving to a specific focus on open learning, the next section of the paper presents a model for Integrated Programming -- illustrating the need for a "laddered" approach to planning educational programs in order to provide learning opportunities that are integrated and sequential from the perspective of the learner. The essential feature of an Integrated Program is that learners have, depending on their goals, educational needs which range from basic information about a subject to complete mastery of the skills and knowledge involved. The third and final section of the paper focuses on an analysis of the Integrated Program model to illustrate the various types of telecommunication technology, and other formats for independent learning, which are most appropriate at different levels of programming. Examples are used throughout the paper using the model of the Knowledge Network and the Post-Secondary system in the province of British Columbia, Canada.

I. INTRODUCTION

The last 100 years have seen a great number of changes in the way we conceive of education -- its ends and the curriculum models designed to achieve those ends, and in the way education is delivered. In this introductory part of our paper we want to present two types of analyses. The first will be focussed on the argument that societal changes, which have occurred around the world, have brought about a shift in the perception that education is a process begun and completed in early life to one which is now recognized as a lifelong process.

The second analysis will attempt to show how the educational delivery system has evolved to one which we call "Open Learning",' which is in response to changes in the way education is perceived and the outcomes expected from investment in it. An important element in our analysis is that this evolution has been permitted and made possible by various technological developments.

Lifelong Learning

The concept of lifelong learning is not a new one to Western Society. Indeed, the term has long been quoted and supported by leaders and educators as an important ongoing process of knowledge and skill acquisition which individuals undertake (consciously or unconsciously) to meet changing personal and societal needs. More recently the discussion of a systematic approach to lifelong learning has emerged. This growing acceptance of lifelong learning is being driven by the pressing demands generated by the growth of new knowledge areas (particularly in areas of technological advances), the changing attitudes of learners related to their educational needs and changing lifestyles in our society. Specifically, this is reflected in a greater level of individual mobility due to economic and career options, a greater emphasis on learning part-time, or at more convenient times, and especially in more convenient locations. Changes resulting from technological advances are rapidly affecting the ways in which people work, and their view of work, but more significantly the impact on how people manage and live their lives. The changing nature of work and living is translating into a heightened awareness in individuals to develop new skills, upgrade their existing skills and acquire new knowledge bases to help them cope with future work, personal and societal changes. One logical solution to this increasing demand is to plan for and implement a systematized approach to lifelong learning.

Evolution of Open Learning Systems

In response to the need for open learning systems, educational institutions have adopted innovative delivery systems, increased access to learning, for those initially who were geographically remote, and for those who were unable to take advantage of learning opportunities due to employment and family responsibilities. The paradigm depicted in Figure 1 (attached) illustrates the evolution of open learning delivery systems. Traditional modes, depicted in Quadrant A, can be characterized as being primarily dependent on the physical presence of a teacher, with instruction being conducted in a centrally located physical facility. The focus is on the student/teacher interaction at a fixed location, the teacher's. As transportation systems became more efficient, the mobility of the teacher increased. The itinerant delivery mode presented in Quadrant B depicts a model which is still teacher-dependent, but free of a fixed location. The opportunity was now available for teachers to travel to remote locations using local community facilities to provide instruction in more remote regions and communities.

Distance Education as described in Quadrant C is defined as learning which is not dependent on the physical presence of the teacher and which does not occur at a fixed location. The earliest example of distance education, enabled by the development of a postal service, was correspondence education, primarily print based and managed in the student's home environment. Recent developments in telecommunications have permitted a more significant amount of the learning to occur through a process whereby the instruction is conducted by a teacher who is remote from the student. Typically, distance education involves a mix of media including television, radio, telephone, computer and print. The use of both land-based and satellite networks for the delivery of education has permitted the student to study at home, in a regional centre, or even at the work site.

The learning modes developed in Quadrant D represent further advances in technological applications in education to include closed circuit systems. These were initially used in highly specialized learning activities first evidenced in experimentation with closed circuit television programming on an intra-institutional basis in the early 1960's. Eventually they evolved to include the design of computer assisted and managed learning activities in the form of local area networks. The delivery modes presented in Quadrant D present an attractive model for classroom management and work specialization.

To date, these activities are seen to be site specific, the primary reason for this is the student requirement for equipment and hardware. As learning materials are developed and more sophisticated delivery systems are perfected it becomes possible to link local area networks into a much expanded concept of delivery, where the variables of teacher dependency and location dependency will become non-issues. The focus becomes that of an appropriate match of learner needs to delivery systems, providing a flexible approach to learning in any context. Open learning systems remove, wherever possible, the restrictions placed on the learner allowing people to learn at a place, time, and pace that meets their requirements. It promotes ease of entry and mobility in learning through the use of a wide mix of teaching strategies, particularly those focusing on independent and individualized learning.

II. PROGRAM DEVELOPMENT IMPLICATIONS

To this point we have argued that our concept of education is shifting from a "youth only" focus to one which is recurring throughout the lifespan. We have also attempted to illustrate how the educational system, through the use of technology, has reacted in order to accommodate changing demands. In spite of these developments however the program offerings remain fragmented as far as the learner is concerned. Because our educational systems are composed, by and large, of separate institutions, organized into system subsets such as colleges, universities, schools, technical institutes, etc., the programs offered lack sequencing and integration. Movement across the "boundaries" of these system subsets is frequently difficult. It also ensures a lack of integration of subject content in that the learner's progress through the system is based not so much on knowledge acquired as it is on whether or not it has been formally accredited.

In a youth oriented model of educational systems this is less of a problem; however, in a model that sees education as a lifelong process, with people needing to learn for a wide variety of reasons and at places, times, and at a pace suited to their circumstance, this situation does present problems. In spite of our uses of telecommunication and other technologies which have enhanced access, we are only just beginning to grapple with the problem of integrating our program offerings more coherently.

An Integrated Model

We argue that to facilitate the lifelong learning process, it is necessary for planners of education and educators to have available to them an integrated program model, to serve as a guide for educational decision making related to matching learner needs to optimal delivery systems. The model must permit learners to achieve their learning goals, to satisfy their place, time, and pace needs regardless of their entry level and to progress in a fashion which is consistent with individual learning styles, content difficulty and delivery method sophistication.

What does this statement imply then in the review of the educational needs of individuals in our society? In his Taxonomy of Educational Objectives Bloom provides us with a useful frame of reference in analyzing these implications. Bloom envisioned learning as that of a series of building blocks, moving from a point of general content awareness through a range of levels culminating in the most advanced or sophisticated approach to learning namely, that ability to evaluate and place a value on what is learned.

Let us begin by reviewing Bloom's six major classifications and their relationship to the traditional methods of delivery. The first level is referred to as knowledge; for our purposes we will refer to this level as awareness. At this point of the learning, the individual can recognize or recall an idea or fact that they have been exposed to. In today's society this responsibility is left to the individual and generally is developed through public media exposure (i.e., newspapers, radio and television) and, in fewer instances, continuing education programs in the community.

Comprehension or the ability to understand and explain a situation is the second level in the taxonomy. This ability is reflected in an individual being able to interpret or communicate facts or knowledge to another. Once again this has traditionally been the primary responsibility of the learner, but would be seen to require additional effort to progress from the awareness level to that of comprehension. Self-directed learning packages complementing the use of television, in offering telecourses, have proven to be good resources in providing more detail for the learner in meeting these learning objectives.

The third level is that of application where individuals demonstrate a need to apply specific knowledge or theory in problem solving. This need is frequently triggered by the desire to complete a task, thus forcing the individual to seek the appropriate source of knowledge. A clear example of this is the desire to conduct home automobile maintenance. In order to achieve this successfully, the individual is faced with learning how to recognize the various parts of a car engine, know their uses and understand the relationships of the parts to each other before they can begin maintaining their automobile.

The ability to analyze is related to application in much the same way that comprehension and awareness are related. It is but a small incremental step to move from application to analysis as the learner's mastery in the subject matter increases and the motivation or learning objectives change. For example, as an individual becomes comfortable using a computer and maybe a particular piece of software, the needs of the learner extend to knowing more about the general construct of computer based technology and an increased curiosity regarding the potential uses of the computer for other activities.

The highest levels of Bloom's model include that of synthesis and evaluation. Both are considered to be higher orders of learning, whereby the learner can amalgamate various elements to create a whole and then make judgements as to the value of the whole through the determination of criteria and standards. This assumes full mastery of knowledge and is based on a progression through all the previous stages of Blooms' model to permit individuals to demonstrate this ability. In our computing example the ability to analyze the uses of software programs and then write personalized software programs with an eye to improvement and specialized purpose would illustrate the concepts of synthesis and evaluation.

On the whole, educational institutions have accepted the challenge of providing learning opportunities which accommodate variable pacing, location and learning objectives. Traditionally, this challenge has been met through a fragmented approach where specific institutions have accepted one specific role, or student group or delivery approach which accomplishes one or more of the desired learning outcomes, but which unfortunately does not allow for a smooth articulation within the broader system.

Figure 2 (attached) is an attempt to use the taxonomy of educational objectives in relation to the types of programs required if the system is to provide the full range of opportunity needed to accommodate lifelong learning.

Recognizing that we are faced with implementing a model within the context of existing educational systems, the "ladders" of learning outcomes depicted in Figure 2 are described in terms common to both the educational providers and the learners. In effect, the process of opening up the system implies that we are starting with a defined system.

There are several observations that can be made about the concept of an integrated program as presented in Figure 2.

Educational programs are sequential in nature in the sense that one leads to another, building upon the growth and development of knowledge and skill in a particular subject. As access to educational opportunities increases through the use of telecommunication, the demand on the part of the learners for such integration increases. A frequent comment from viewers of general education programming on the television part of our

Knowledge Network is "That was very interesting. I'd like to know more about that subject. What's next?"

General observations can also be made about the characteristics of students involved in the various types of programs portrayed in the model. For example, the absolute numbers of students involved decrease as one moves from the general education programming portrayed at the base of the pyramid to those programs with more demanding educational outcomes, such as university degrees, found nearer the apex of the model.

Because the types of programs become more demanding in terms of the commitment required from the learner, it can also be assumed that the motivation level of students also increases. They tend to be clearer in terms of their educational goals and, because they have chosen to pursue those goals through an open learning methodology, are very likely people who previously have not had the opportunity.

Increased learner motivation has some important implications regarding the decisions about the level of production investment that needs to be made in the educational materials for the various programs. For example, it is most likely that the investment in materials for a general education type program will need to be higher, in order to sustain learner interest, than will be the case for an upper level course in a university degree program. In the latter case, the student is considerably more oriented to acquiring the information, whereas the student in the general education program is more likely to be attracted initially, and retained, if the materials are themselves more visually appealing with the information "packaged" in smaller units. This is particularly true when video materials are involved. The general education student is most likely to be using the production values found in conventional commercial television as their frame of reference and therefore more likely to discount its value if it is perceived as "not measuring up".

The model is also useful in making some general decisions regarding the most appropriate technology for the delivery of various programs. For example, given that one of the goals of general education programming is to reach large numbers of the population, it follows that television is an appropriate delivery medium. Our past experience has also demonstrated that radio networks are very effective as a telecommunication tool to deliver general education programs. Indeed, we may well be ignoring this medium in the face of newer technologies.

As one moves up the "ladder" of programs in the model, the need for interactivity between the learner and an instructor increases. The typical "one-way" character of television becomes insufficient unless supplemented with other modes of instruction. Teleconferencing, computer conferencing, local resource persons and exchange of print materials through the mail service are all ways in which this can be accomplished.

While broad-band technologies involving satellite, cable and fibre optics are of increasing importance, their application at this point is somewhat limited when programs which require interactivity between teacher and learner must be delivered over a broad geographic region on a point to multipoint basis. The use of narrow-band technologies, using the existing telephone systems, therefore becomes important. By incorporating the use of telewriters, slow-scan and compressed video, viewphone and other similar technologies, integrated with bridging devices, much of the instructional design required in the types of programs described in the upper part of the pyramid model can be effectively carried out, probably at lower cost, and without tying up a significant portion of a public television schedule for a relatively small number of students.

III. OPEN LEARNING IN BRITISH COLUMBIA

The province of British Columbia covers 950,000 square kilometers, has a rugged mountainous terrain, with a population of approximately 2.7 million people. Over half of the population lives in the southwest corner of the province comprised of the metropolitan areas of Vancouver and Victoria.

The educational system in the province has evolved over the years to include three universities, all in the metropolitan areas, 15 regional colleges and institutes and a comprehensive public school system serving kindergarten through high school. These institutions, like their counterparts elsewhere, developed as traditional providers of education with instruction carried out in the manner described in Quadrant A of the model depicted in Figure 1. As pressures grew to accommodate more students, and to provide better access, more traditional institutions were built.

While this process was, and to some extent still is going on, there was also recognition that many adult students could not be served by the delivery mode typified in Quadrant A. As a result there developed the Quadrant B type of delivery which we have called "itinerant".

The University of British Columbia, like many others, for years conducted off-campus courses in communities where a sufficient demand for a specific course was identified. Travelling by car, bus and air, professors would meet with students in schools, halls and church basements.

Colleges in the province, which mostly began with a central campus to which students come, developed satellite and store-front operations in response to this need, and engaged in the itinerant outreach type of delivery.

Early forms of distance education (Quadrant C) emerged as well from the traditional institutions. The first of these was correspondence education. In our province, the University of British Columbia developed a correspondence program many years ago with the provincial Ministry of Education establishing a Correspondence Branch in the 1920's to ensure that the public school curriculum was available to students not able to attend the traditional school system. More recently the province established an Open Learning Institute to provide adult basic education, career/technical/vocational and university programs through distance education delivery methods. Those chosen were essentially print based, using a system of tutors at the local level. In 1980 the Knowledge Network was created to provide a telecommunications network for the delivery of education in cooperation with the traditional institutions. The principal mode of delivery was, and still is, television with signal distribution through satellite and local cable systems.

While this rapid expansion of Quadrant C type of delivery models has served to improve student access in a remarkable way, many of the program-related problems associated with the traditional system remain. Lack of program articulation and integration associated with the traditional system has remained in the sense that distance education methods have been used primarily to create individual access to the programs that exist in traditional institutions. The emphasis to date has been on designing those programs in ways to maximize instructional effectiveness and appropriate use of media.

The most recent development in this evolution, in British Columbia, has been the merging of the Open Learning Institute and the Knowledge Network to create a new organization to be called the Open Learning Authority. The Authority will have a program mandate to provide open learning programs ranging from general interest to university degrees including a major emphasis on adult basic education and job-skill training working with private sector employers. It has also a mandate to continue to provide a telecommunication-based delivery system through which these programs can be offered. The addition of a teleconferencing capability, the use of computer networks, telewriters, slow-scan and compressed video will permit the development and delivery of programs for specific groups and individuals while, at the same time, continuing to review the general educational needs of larger audiences. These developments will create new opportunities for the type of delivery which we have called "closed-circuit" in Quadrant D of our Figure 1 model. This will see a meld of face-to-face teaching combined with independent study on the student's part using learning "software" that may be available in sites ranging from the classroom to international data bases.

Examples of this trend are already occurring in the traditional institutions where course materials developed for delivery in distance education modes to serve off-campus students are being used in the on-campus classrooms.

The evolution of the British Columbia educational system is not unique. We see a similar pattern all around us. What may be more unique is the mandate of the new Open Learning Authority to work with and involve the traditional institutions in the system rather than taking sole responsibility for the provision of open learning opportunities. In that sense, the Authority will have a coordination and animation role in addition to being an educational institution in its own right.

It is arguable that much of the development in telecommunication technology has occurred in response to non-educational needs. As a result, educators have largely been in the position of adapting to existing technology. As educational systems come to utilize telecommunications more and more they must also have input at the design stage of new technology. Mechanisms must be developed to permit this and partnership arrangements put in place to carry out research and development and demonstration projects.

FIGURE 1: THE EVOLUTION OF OPEN LEARNING SYSTEMS

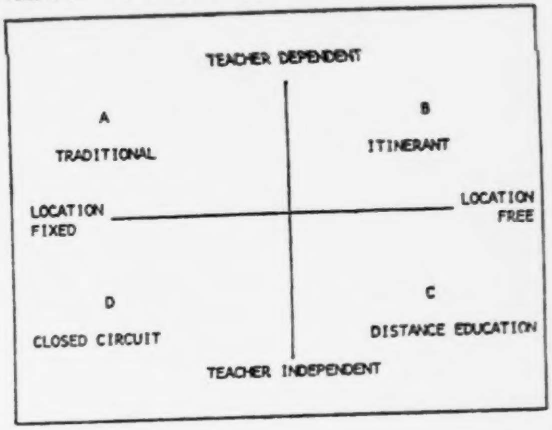
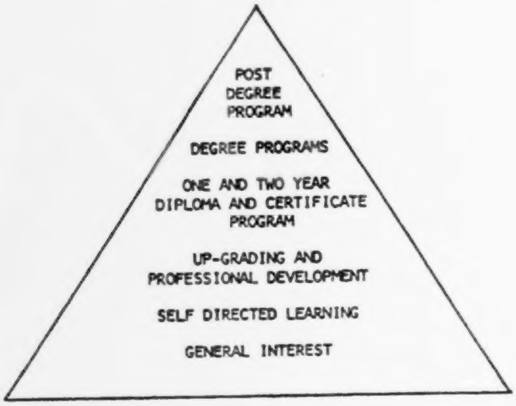

TEACHER DEPENDENT
A
TRADITIONAL
B
ITINERANT
LOCATION FIXED
LOCATION FREE
D
CLOSED CIRCUIT
C
DISTANCE EDUCATION
TEACHER INDEPENDENT

FIGURE 2: INTEGRATED PROGRAMMING MODEL


POST DEGREE PROGRAM
DEGREE PROGRAMS
ONE AND TWO YEAR DIPLOMA AND CERTIFICATE PROGRAM
UP-GRADING AND PROFESSIONAL DEVELOPMENT
SELF DIRECTED LEARNING
GENERAL INTEREST

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Telecommunications Technology and Special Education Needs In The Pacific Region

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Two of the "megatrends" identified by John Naisbitt suggest radical changes for schooling in the future. We have moved from an industrial society to an information society -- communications satellites, which have "turned the earth inward, upon itself" are the quintessential instrument of this trend. They allow the efficient exchange of information across vast distances. Individual nations and world systems are moving away from centralized institutional responses to social problems and toward decentralized self-help solutions.

The effect of these changes on schooling is obvious. In the United States the number of and enrollment in private schools has grown markedly in the last fifteen years. Even more significantly, the number of children educated at home appears to have increased by a factor of 100 in the last decade (from about 10,000 to over a million). Although changes in the nature of schooling made possible by the technological revolution may be a source of frustration to many urban educators, the same technologies may enable rural and remote schools to finally provide meaningful and intensive distance education to students with special needs. These changes are particularly salient for island nations in the Pacific and sparsely populated areas of the United States and Canada. Unlike countries such as New Zealand, many North American rural areas have had little experience with distance teaching.

Rural and remote areas face particular problems in educating children with special learning needs. The specialized skills common to urban areas (e.g., physical therapy, speech therapy, specialized instructional skills) are not available and simply cannot be made available economically in rural areas. Similarly, providing specialized curriculum to meet the learning needs of a small number of pupils (whether that is German language instruction, or a tailored math program for a learning disabled student) can be extremely difficult in rural areas. Distance education promises a solution to those problems, but the promise has not been kept yet for most rural areas.

A major obstacle to making quality distance education available is that decision-makers who choose what to provide and how to do it rarely have sufficient information available to them. Most often they find brief descriptions of particular applications (e.g., the use of electronic mail to communicate with parents in rural Canadian provinces) or characteristics of various technologies (e.g., two-way video satellite communication is prohibitively expensive).

What is lacking is a clear way to match the variety of tasks required of a rural educator with a range of potential technological applications, including innovative uses of more traditional and less expensive technologies. The result is that the potential user too often falls victim to technological determinism and ends up either buying whatever communication system someone is selling or simply adopting an application developed elsewhere. In both cases, the user may end up with unused capacity (the norm for cable installations in schools) and equipment inappropriate for tasks that need to be performed (e.g., an instructional TV apiplication with no capacity for text transfer).

The unique conditions faced by remote and rural educators with very small target populations require new ways of thinking about how to satisfy communication needs economically and efficiently without sacrificing human factors. In order to assure that adopted technologies are the most appropriate for specific situations, decision-makers must be apprised of how to go about choosing and implementing distance teaching systems.

First, the focus must be on the kinds of tasks that must be performed across distances, that cannot be performed for a variety of reasons through face-to-face interaction. Task demand assessment has to account for administrative, teacher recruitment/retention, teacher training/support, student instruction, resource provision and other kinds of needs.

Once a clear idea of the range of tasks to be performed has been acquired, then specific economic, political, geographical and cultural factors have to be considered in choosing from combinations of technologies, rather than single technologies, that can be used to perform identified tasks. Technological surveys should examine all ways information can be moved across a distance -- not just those that have the glamour and flash of microcircuitry and geosynchronous orbits.

Most importantly, decision-makers have to consider how the people who will use the distance education system are likely to interact with any suggested technological combinations. Technologies that are culturally inappropriate, devastatingly costly to maintain or geographically unsuitable will benefit no one ultimately except, perhaps, the companies who sell and service the quipment.

Finally, decision makers need to consider maximum and innovative uses for existing systems of communication before adding any new technologies. Sometimes old equipment can still work well, maybe even better than wonders of the modern age, given certain circumstances and specific people.

Enriching Classroom Experiences and Career Opportunities Through Telecommunication Technologies: The Global Education TELEclass Project Partnership Model

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1. Abstract

This paper traces the origin and organization of the Hawaii Global TELEclass Project (Telecommunication Enriches Language Experiences) and proposes it as a model for enriching classroom experiences and career opportunities and promoting partnerships that involve multi-mode, computer-based, educational telecommunication programs. It also discusses the potential that these partnerships have for developing curriculum and for minimizing related program costs while increasing program impact for students.

2. INTRODUCTION

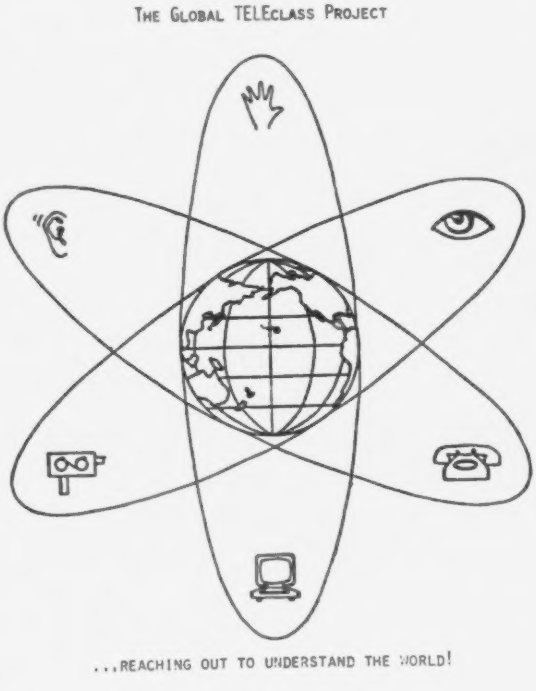
2.1 BACKGROUND

Students today want immediate gratification from, and practical application of their school work. They want to be stimulated to learn from formats similar to that of Music Television (MTV). The idea for the TELEclass Project resulted from observing enthusiastic students working with computers and realizing that one can dial almost anywhere in the world directly. It is a supportive program which uses available technology so that students can have direct and electronic communication with peers in targeted language countries. It is intended to motivate students to become fluent in a language and to be culturally informed through a realistic and practical environment.

TELEclass *(1)* officially began in 1985 as a co-operative, international, educational telecommunication program, sponsored by the **Hawaii State Department of Education (DOE)**, to promote language learning by linking foreign language students with counterparts who are learning English overseas. The following project and organizations were instrumental in its inception.

The National Association of Laboratory Schools (NALS) has been involved in TELEclass development from the start *(2),(3)*. Following pilot telecommunication activities at the **University of Hawaii (UH) Laboratory School**, a grant was obtained by Dr. John Wollstein, Coordinator for Asian, European and Pacific Languages in the Hawaii DOE to explore the feasibility of utilizing telecommunication techniques to enhance foreign language instruction in secondary schools. Representatives of NALS member-schools met in Reston, Virginia, in 1983 to discuss possibilities for attaining that goal. Subsequently, the Hawaii DOE received the grant to pilot test TELEclass between

FIGURE 1
THE GLOBAL TELECLASS PROJECT



...REACHING OUT TO UNDERSTAND THE WORLD!

schools in Hawaii and overseas. Later, TELEclass was demonstrated at the NALS 1986 conference held in Chicago. That conference provided an invaluable setting for developing possible TELEclass involvement for various NALS schools which have appropriate interest and facilities. Many conferees have followed TELEclass development and hope to assist in testing/dissemination of the program on the mainland.

Project ImpAct (IMPortant ACTivities for Education Through Telecommunication) *(4)* was an outgrowth of the UH Strategic Plan for the decade 1985-95. *(5)* The project brought together professional organizations, with members in the University of Hawaii system, to work on implementing various pilot uses of telecommunication related to education, administration, and research. Special emphasis was placed on opportunities for strengthening the Strategic Plan objective of improving cooperative links between UH and the Hawaii DOE. Major outcomes of Project ImpAct were an organizational structure based on its cooperative partnerships and the funding of the TELEclass Project. *(6)*

Career Kokua (CK), the Hawaii Career Information Delivery System (HCIDS), provided TELEclass access to statewide telephone and computer networks in public high schools. It is the state's six-year-old, computer-based, annually-updated career information program used in Hawaii, American Samoa, and Guam. Its 110 user sites represent over 100,000 users in all state high schools, colleges, and universities; almost 50% of the intermediate schools, three elementary schools, state and private rehabilitation agencies, Alu Like Service Centers, six private high schools and colleges, and private counseling services. It is administered by the Research and Statistics Office of the Hawaii Department of Labor and Industrial Relations (DLIR) with policy and direction provided by the Hawaii State Occupational Information Coordinating Committee (HSOICC), an interagency consortium authorized by state law.

The goal of CK is to positively impact career decision-making by providing current, accurate, locally-relevant career information. *(7)* This goal corresponds to DLIR's objective of full, satisfying employment for all people. To achieve this, career training is annually conducted to update professionals on system use and to ensure quality services to the end user.

2.2 TELECLASS PROJECT

Basic to the organization of TELEclass has been a series of partnerships with public and private agencies. The combination of services, equipment, and personnel provided by these partnerships has provided for greater efficiency and effectiveness in the implementation of the project.

The Curriculum Research and Development Group (CRDG) of the College of Education operates the University Laboratory School, where the basic telecommunication techniques were first piloted. *(8)* The CRDG-DOE relationship was the originating partnership for the project, conceived by Dr. Wollstein. CRDG provides assistance to the DOE in the form of cooperative curriculum development, project implementation and evaluation. However, it was predominantly in the latter two activities that CRDG's assistance was sought before launching TELEclass in the fall of 1985.

CRDG's development of statewide communication links based on UH's Digital Equipment Corporation computer electronic mail system has permitted an efficient means for information exchange with educators statewide. This arrangement has been of major importance in helping meet the Strategic Plan's objective of encouraging greater cooperation between the various members of the UH College of Education and local schools and administrators throughout the state. Successful electronic mail/bulletin board techniques have been incorporated into plans to develop a **Network of Educational Information Exchange (NEIEx)** for continuing communication with educators. *(9)*

CK's TELEclass involvement in the fall of 1985 enabled first-time use of its existing statewide computer, telephone, and career information networks for the specific foreign language curriculum applications. With approval from the participating TELEclass schools for use of computer and phone equipment, electronic mail accounts were initiated to access this new communication resource. Speakerphones were loaned to selected schools for use with existing phones dedicated to CK use. Educational and occupational information specific to foreign language skills was extracted from the existing career database for distribution to TELEclass schools. *(10)* This information was designed to motivate students to use the computer for other files of career information. Electronic mail not only facilitated project administration but also supported messages written in foreign languages between and among teachers and students. Speakerphones encouraged students and teachers to practice their oral language skills. Analysis of project outcomes after the successful first-year partnership has resulted in expanded career information exploration using telecommunications in other curricular areas. *(11)*

During Project ImpAct, various local professional telecommunication organizations provided additional partnerships. Endorsements of TELEclass, featuring it during programs and conferences, and even personnel assistance in carrying equipment to schools overseas were examples of the help private agencies have given to support TELEclass. *(12)*

Individuals have also been important in a variety of roles. Some have been associated with the above-mentioned professional associations; and others, like Dr. Takeshi Utsumi, President of Global Associates in New York City, have supported TELEclass in a variety of ways. For instance, Dr. Utsumi has been one of the most enthusiastic TELEclass promoters in the hope 1) that it will help motivate students in Japan to learn better English and that 2) it will help to make for a world where people both know and understand each other better. As of the time of publication, the authors have never met Utsumi face-to-face but meet almost daily via computer mail.

TELEclass is based on the concept of **Computer-Based Educational Telecommunication (CBET).** *(13)* CBET involves the use of electronic computer communication for both project coordination and substantive student-to-student communication. CBET involves multi-media (e.g. computer, audio, video, slides, tapes) but requires a computer communication link with participants for maximum efficiency. It is significant, when considering costs, to recognize the inherent economy of bandwidth and expense. Computer data communication by terminal or microcomputer is the most economical form of telecommunications. A single voice channel takes the bandwidth equivalent to that needed for 1000 computer links. A single full-motion video channel requires the same bandwidth as 1000 voice links. Despite the continuing drop in price of communication links, economy of scale will continue to favor the "narrowband" type of systems.

TCnet is the TELEclass Multi-Mode Network. *(14),(15)* As mentioned above, the **UH Computing Center (UHCC)** statewide communications network has been central to coordination among TELEclass schools in Hawaii. Overseas and mainland U.S. contacts are made with the Electronic Information Exchange System (EIES). *(16)* Another network has involved MCImail and telex communications use.

Audio communication by school groups has often involved use of inexpensive speakerphones (e.g. Duofone 101/102 models from Radio Shack). Project coordination has utilized Hawaiian Telephone Wonderphone and Phone Plus options. The former permits three-way calling and call-forwarding. In planning international TELEclass sessions with persons not speaking English, the three-way calling with a translator saves much time by permitting complete planning, often with a single phone call. Phone Plus is an on-line, system message answering system. This permits 24-hour-a-day message acceptance. In one case, before the computer mail links in Japan were worked out, staff members exchanged messages using the TELEclass Phone Plus telephone (voice) "mail box".

Honolulu Cellular Telephone Company (HCTC) has provided cellular phones for project use. This permits almost total portability on the island of Oahu in voice, video, and data exchanges.

Multiple audio, video and data telecommunication is possible with a conferencing bridge. Two specific bridges that have been used are the **UH TelAIR** Westell five-port bridge (located at PEACESAT) and the 59-port **AT&T Alliance bridge.**

Colorado Video, Inc. and **Luma Telecom, Inc.** provided hardware which furthered the use of synchronous audio and video telecommunication. These vendors provided equipment for experimental testing in the international arena of TELEclass programming. Colorado Video maintains an informal network of over forty compatible SlowScan Television (SSTV) units around the country and abroad. *(17)* These permit low-cost video enhancement for TELEclass sessions.

Over 50 TELEclass sessions were held between September 1985 and June 1986 with the following locations: Japan, Korea, Hong Kong, Shanghai, Taipei, Canada, Puerto Rico, Germany, France and the mainland U.S. These involved experiences ranging from local practice sessions to sessions occurring during major conferences. The largest involved about 800 students during a TELEclass session in a school assembly in Taipei, Taiwan. *(18)* International cooperation by schools and agencies overseas was also an important factor in the success of TELEclass and general ease and freedom from restriction in every country visited.

A classic example of what cooperative activity can produce took place September 1986 during the **Hawaii Intergovernmental Information Processing Council (HIIPC)** conference on the Island of Hawaii. A transcontinental/transoceanic Spanish TELEclass session was held simulataneously with an interisland session within **Hawaii.** Students from Konawaena High School's **Spanish Class** came to the Sheraton Waikoloa Hotel and spoke Spanish with students in San Juan, Puerto Rico as well as with Roosevelt High School students on the **Island of Oahu.** The latter group was featured as part of **Hispanic Week at the U.S. Army Ft. Shafter** base in Honolulu. Officials of **AT&T** at the HIIPC conference coordinated their Alliance bridge linking of audio and video (featuring **Colorado Video SSTV between Hawaii and Oahu)** while **Honolulu Cellular Telephone Company** on Oahu provided portable phone capability. In San Juan, the **Puerto Rican Teachers' Association** coordinated the students from the Pabia Rufo School. It was a TELEclass partnership event par excellence!

Observations and comments from project participants indicate that TELEclass has made some impact in the classroom. *(19)* One teacher has observed that enrollment increased more in the language in which TELEclass activities occurred. Students and teachers have requested pen pals to continue communication initiated by TELEclass links. Classes were able to apply general communication skills in these transmissions. These included generating posters and other aids during project links to uniquely communicate information about themselves. Participants have improved their use of telecommunication equipment and communication procedures as evidenced in the decreasing need to explain equipment use and to monitor speakers' clarity and speed. Project participants request more TELEclass activities despite problems that have sometimes occurred in their initial experience. Schools initiated planning meetings during TELEclass exchanges that preceded overseas visits to sister schools. Teachers and administrators in other curricular areas have expressed interest in this project. DOE's designated Language Learning Center specialty school is incorporating TELEclass activities as an integral part of their foreign languages curriculum. The Science Learning Center is similarly adapting the procedures to support science curriculum.

There are two outcomes that surprised project administrators: 1) participants' interest and use of technologies in communication between and among local schools; 2) ease and rapid transferability of the telecommunications procedures and skills to career experiences and to other curricular areas. Individual teacher interest has been key to the local dialogues. These teachers have initiated their own networks to support use of the technologies to foster foreign language studenty. Practice between some have even initiated training for their peers. The career outcomes are described in the next section.

2.3 Career Opportunities and Career Information Delivery

Hawaii, along with the nation and the world, is experiencing rapid societal change due to technological advances. These advances have not only altered the nature of available jobs, but have also compounded the problems of career selection. Rapidly changing career information that doesn't reach the career decision-maker has meant a labor force less adequately trained and suited to employer needs. In addition, while unemployment rates have been high, employers are already experiencing shortages of workers due to lower birth rates. In its, The New American Boom, Kiplinger Washington editors forecast a native-born birthrate below replacement levels and population growth at 12% over the next 15 years. *(20)*

In the November, 1986 United Airlines inflight magazine, Richard J. Ferris, UA Chairman, editorializes in his column, "The Changing World of Work," that training is essential for upgrading the work force for the different skills required by new technologies. He estimates that U.S. corporations spend $60-$100 billion for employee training and anticipates increased expenditures related to predictions that 75% of the work force will need retraining by the year 2000. In a statement that relates to TELEclass objectives, he recommends that one of three activities corporations must undertake to address retraining needs is to "anticipate better the effects of technological and economic changes on business and employees". Of two recommendations for educational institutions, he encourages training programs developed in cooperation with business.

In order to assist individuals to cope with technological change and gain the information they need to avoid finding themselves obsolete in the job market, career information delivery systems such as Career Kokua can:

1) collect, centrally store, update and deliver massive amounts of data that can be categorized and organized into useful, individually tailored career information. That information can be accessed by telephone without the deterence of distance from resources, age, sex, employment status and other former barriers to information access.

2) help people to learn which occupations offer suitable prospects and how to prepare for such occupations.

3) help reduce the effects of sex, age, and handicap biases by allowing an accurate assessment of the opportunities offered, and skills and abilities required by various occupations which may motivate users to opt for occupations which they might not have otherwise considered.

4) help reduce the effects of geographic isolation and economic disadvantage by broadening the horizons of youths/individuals who may have had less opportunity to be exposed to a variety of occupations. Provide an accurate assessment of opportunities offered, and skills and abilities required by such occupations.

5) reduce the number of poor career choices made because of lack of information, thus reducing the negative effects of uninformed choices on individuals and society.

6) introduce people to the computer and other technologies so that they are seen as aids rather than as threats, thus reducing anxieties about using equipment...thus reducing user anxiety.

All U.S. states and territories have career information available. As of June 1986, only Guam, Massachusetts, New Hampshire, Northern Mariana Islands, Texas, American Samoa, and the Virgin Islands did not have a computer-based, statewide system. *(21)*

Career Kokua and its user sites had been using modems and telephones to access its database. At the same time, use of this and other telecommunication resources for other career exploration activities occurred owing to recommendations from and affiliations with units in the DOE, UH, and the eventual partnership with the Global TELEclass Project. Training manuals and courses that provide more information on telecommunications are being cooperatively developed and evaluated. New resources and partnerships continue to be developed.

Use of telecommunication resources has resulted in: new ways to use existing career information; language and cultural exchanges between foreign language learners and native speakers; having remote sites able to access career speakers and obtain information from post-secondary school representatives who would not otherwise have been available to them; improved communication between users and CK staff; increased awareness of telecommunication resources and related occupations; making available role-models for under-represented groups in occupational categories of employment; career information use by groups/curriculum content areas which hadn't previously used CK; access to career seekers and speakers with handicapping conditions that make contact through any other means very difficult; new partnerships with public and private agencies which share compatible concerns about technologies that contribute to improved learning and career awareness;

improved training for CK user sites; incorporation of telecommunication use by service providers. *(22)*

What continues to be demonstrated in all of this activity is that the cooperative, partnership model by which State Occupational Information Coordinating Committees (SOICC's), Career Information Delivery Systems, and TELEclass were developed is essential to the broadening and strengthening of CIDS program use. And, it is through these partnerships that telecommunication resources truly expand career opportunities for career seekers.

3.0 THE PARTNERSHIP MODEL

3.1 AGENCY PARTNERSHIPS

Partnerships have been characterized in such well-known adages as "the whole is greater than the sum of its parts" and "two heads are better than one". Commonalities of goals, benefits, and concerns are reasons for partnerships. TELEclass continues to demonstrate that educational institutions working in cooperation with telecommunication companies and a career information delivery system produce expanded career opportunities and enrich learning experiences for students. These outcomes warrant replication of the partnerships to improve learning environments, career selections, and quality of life throughout the world.

"Unfortunately, there is not a long tradition of public-private partnerships in the United States," writes Kent Keith, former Director of the Hawaii State Department of Planning and Economic Development. *(23)* However, in order to maximize resources to stimulate economic growth and jobs, he proposes that government's primary goal be that of fostering such alliances.

While the TELEclass model is not intended to stimulate economic growth and jobs, it does bring government or public agencies together with those of the private sector to stimulate student learning and expanded career opportunities. These are necessary elements for the production of a labor force ready for economic development activities.

The following outline identifies the four major components of the recommended partnership model. The order of importance of these components should be prioritized by circling one of the four numbers provided in parentheses. Priority will be determined by the desired outcomes. Questions are provided in each of the components to guide an agency through an analysis of the specific elements that need to be considered for achieving the desired goal from the resulting partnerships.

(1,2,3,4) 3.1 AGENCY PARTNERSHIPS

3.1.1 Public Agencies

TELEclass partnered the state foreign language unit of a secondary educational institution with a curriculum research unit of a post-secondary educational institution and the government agency administering CIDS. This provided a specific learning environment for the curriculum developed to use the selected technologies and also specified the particular career experiences.

ANSWER AND ADD TO THE FOLLOWING QUESTIONS TO DETERMINE THE SELECTION OF PUBLIC AGENCIES.

3.1.1.1 *With which secondary educational institution(s) do I want to work?*

3.1.1.1.1 *With which unit(s) do I want to work?*

3.1.1.2 *With which post-secondary educational institutions(s) do I want to work?*

3.1.1.2.1 *With which unit(s) do I want to work?*

3.1.1.3 *Which agency administers the CIDS program or provides career information?*

3.1.1.4 *Other:*

3.1.2 Private Agencies

Private agency partners were determined by their telecommunication resources and/or their willingness to participate.

ANSWER AND ADD TO THE FOLLOWING QUESTIONS TO DETERMINE THE SELECTION OF PRIVATE AGENCIES.

3.1.2.1 *With which data agency(ies) do I want to work?*

3.1.2.1 *With which audio agency(ies) do I want to work?*

3.1.2.3 *With which video agency(ies) do I want to work?*

3.1.2.4 *Which agency(ies) provide bridging services?*

3.1.2.5 Other:

(1,2,3,4) 3.2 TECHNOLOGIES

Technologies were selected to address linking multiple sites, flexibility of use in a school setting, minimizing costs, providing optimal sensory stimulation, geographic isolation of schools from resources. The reader is directed to section 2.2 for details on the technologies listed below.

ANSWER AND ADD TO THE FOLLOWING QUESTIONS TO DETERMINE THE SELECTION OF TECHNOLOGIES.

3.2.1 Computer Communication Systems

3.2.1.1 *What type of computer communication do I want to use? (Bulletin/Electronic mail; local/regional/state/national/international)*

3.2.2 Audio Communication Systems

3.2.2.1 *What audio communication systems do I want to use? (point-to-point speakerphone; cellular phone; conference bridge; special phone features-voice mail, wonderphone, phone plus, etc.)*

3.2.3 *Video Communication Systems*

3.2.3.1 ***What video communication systems do I want to use? (slow scan TV/full motion TV/slides/videotapes)***

3.2.4 Other:

(1,2,3,4) 3.3 EMPLOYMENT

While TELEclass exploration activities focus specifically on those occupations and programs that relate to foreign language skills, the following are occupational categories to consider.

ANSWER AND ADD TO THE FOLLOWING QUESTIONS TO DETERMINE THE SELECTION OF EMPLOYMENT CATEGORIES.

3.3.1 Professional, Technical, or Managerial Occupations

3.3.1.1 ***What occupations in this category do I want to promote?***

3.3.2 Clerical and Sales Occupations

3.3.2.1 ***What occupations in this category do I want to promote?***

3.3.3 Service Occupations (food preparation; personal, protective, domestic service)

3.3.3.1 ***What occupations in this category do I want to promote?***

3.3.4 Agricultural, Fishery, Forestry Occupations

3.3.4.1 ***What occupations in this category do I want to promote?***

3.3.5 Processing Occupations (metal, food, paper, chemical)

3.3.5.1 ***What occupations in this category do I want to promote?***

3.3.6 Machine Trades Occupations (operating machines that cut or print)

3.3.6.1 ***What occupations in this category do I want to promote?***

3.3.7 Benchwork Occupations (making, assembling, repairing objects)

3.3.7.1 ***What occupations in this category do I want to promote?***

3.3.8 Structural Work Occupations (construction, welding, electrical, painting, plastering)

3.3.8.1 ***What occupations in this category do I want to promote?***

3.3.9 Miscellaneous (moter, freight, transportation, utilities)

3.3.9.1 ***What occupations in this category do I want to promote?***

3.3.10 Other:

(1,2,3,4) 3.4 CURRICULAR AREAS

Foreign languages were the emphasis for TELEclass but the following are other curricular areas to consider.

ANSWER AND ADD TO THE FOLLOWING QUESTIONS TO DETERMINE THE SELECTION OF CURRICULAR CATEGORIES.

3.4.1 Arts and Humanities (Social Studies)

(As an example of the flexibility of the TELEclass technologies to other teaching areas, a social studies teacher is planning to incorporate telecommunication in an international curriculum development project related to ocean fisheries and bays and harbor.) ***(24)***

3.4.1.1 ***What activities would develop skills in Arts and Humanities and support their learning environment?***

3.4.2 Counseling and Guidance

(*"Electronic Mail: A Career Kokua Telecommunications Workshop"*, is an example of training material developed to assist counselors to use a computer communication resource that they had formerly used solely for career information retrieval.)

3.4.2.1 ***What activities would support counseling and guidance services to students?***

3.4.3 Health and Physical Education

3.4.3.1 ***What activities would develop skills in Arts and Humanities and support their learning environment?***

3.4.4 Industrial and Practical Arts

3.4.4.1 ***What activities would develop skills in Industrial and Practical Arts and support their learning environment?***

3.4.5 Language Arts

3.4.5.1 ***What activities would develop skills in Arts and Humanities and support their learning environment?***

3.4.6 Science and Math

(See Southworth and Klemm, 1985, **for examples of telecommunications use in science.)**

3.4.6.1 ***What activities would develop skills in Science and Math and support their learning environment?***

4. RECOMMENDATIONS

Educational telecommunication school partnerships are recommended for individuals and agencies which want to improve learning and career opportunities for students. Participation is recommended in the following ways.

1. Initiating and/or supporting TELEclass activities.

2. Funding for TELEclass development and continuation.

3. Donation and/or loan of equipment, personnel, and other resources for TELEclass activities.

4. Endorsement of TELEclass activities.

5. Sponsorship of student telecommunications clubs.

6. Participation as a reviewer and/or supplier of career information for career information delivery systems.

7. Providing career speakers and opportunities for students to find out about what people do in jobs like yours and at your agency.

8. Consultation with schools and career information delivery systems on use of telecommunications.

9. Initiating TELEclass activities in other curricular areas - language arts, science, mathematics, industrial arts, guidance and counseling, humanities.

5. FOOTNOTES

(1) *Figure 1* shows the Hawaii Global TELEclass logo. interestingly, this was drawn by CRDG student assistant artist Takio Mogi, whose brother Toshi was a pioneer TELEclass student participant at Kailua High School in 1985. The logo represents the synergy of the independent components creatively working together. *Figure 2* presents the TELEclass Network as of December 1986.

(2) NALS is composed of laboratory schools located at university campuses throughout the country. The University of Hawaii Laboratory School is an active NALS member school.

(3) See Southworth, 1982, 1985.

(4) See Southworth, 1986.

(5) The University of Hawaii Strategic Plan "A Strategy For Academic Quality, 1985-1995." Report developed during the spring 1984 semester by more than 200 faculty and staff who participated in the Strategic Planning Colloquium and Task Group process. The plan was approved by the University of Hawaii Board of Regents on 27 July 1984.

(6) University Lab School faculty member Carolyn Towata entered the realm of educational telecommunication as a member of the honorary educational sorority Delta Kappa Gamma (DKG). As part of Project ImpAct, DKG sponsored telecommunication workshops for its members. *(See Towata. 1986).*

(7) See Coordinator's Handbook. 1985.

(8) See Edwards, 1984.

(9) Alaska's development of a successful computer communication network involving the University of Alaska and the Alaska Department of Education is another example of a technological partnership aiding a geographically-diverse educational system similar to Hawaii's. (See *"Educational Telecommunications for Alaska"*) The Alaska network resource is the type NEIEx hopes to provide initially, on a limited scale, in Hawaii.

(10) See Ishimaru, 1985.

(11) See Ishimaru, 1986.

(12) The NALS Executive Board unanimously endorsed TELEclass at its February 1986 conference in Chicago and urged implementation of a plan to permit its member schools to participate.

(13) See Southworth, 1982.

(14) See Southworth, Flanigan, & Knezek, 1981.

(15) See Glatzer, 1983.

(16) See Hiltz and Turoff, 1978.

(17) See Swift, 1983.

(18) See Wollstein, 1986.

(19) See Saka & Lai, 1986.

(20) See Career Opportunity News. 1986.

(21) See 1985-86 Career Information Delivery Systems, 1986.

(22) See Parker, 1984.

(23) See Keith, 1985.

(24) See Ramsey, 1983.

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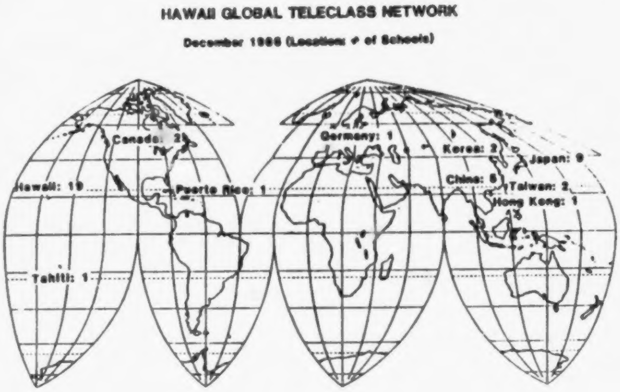

FIGURE 2

The Impact of Telephone Networks on Rural and Educational Development: Experiences of the AID Rural Satellite Program

Karen Tietjen, Willard Shaw, and Clifford Block*

Telecommunications has had a powerful impact on development in rural areas of Peru and Indonesia. The AID Rural Satellite Program demonstrated new ways of providing telephone service and transformed the telephone into an educational tool through the addition of simple audioconferencing equipment.

INTRODUCTION

The tremendous growth in worldwide telecommunications services in the last few decades has caused revolutionary changes in the conduct of business, banking, trade, and politics in both the domestic and international arenas. The economies of industrialized nations increasingly depend on telecommunications networks for a multitude of services. The dozens of satellites orbiting the earth have created a worldwide communications system that truly makes the world a "global village" for those people with access to this system. The vast majority of the world's real villages, however, are generally cut off from domestic and international systems, not by choice but by circumstance.

Telecommunications services have been slow to reach into most rural areas of the world for several reasons: high costs, technical problems, and lack of a guaranteed return on investment. It is both cheaper and more profitable to develop telecommunications infrastructures for urban rather than rural areas. There is also the feeling among some planners that rural areas do not need or cannot really use telecommunications facilities and that the positive effects of providing such facilities does not justify the expense and effort. Some would say that basic telephone service cannot be provided until the users are able to pay for the costs. However, there is now a growing realization among experts that telecommunications is an essential ingredient that hastens development and is not merely a result of it. A reliable telecommunications infrastructure can facilitate economic growth and promote national development aims. Telephone services to rural and remote areas can stimulate economic development and bring the rural resident closer to the mainstream of national life. There is also a growing feeling that access to communications facilities should be viewed as a social service to be provided by governments as they provide schools and not merely looked at in terms of the bottom line of a balance sheet. The Rural Satellite Program (RSP) of the United States Agency for International Development (USAID) experimented with a variety of ways to provide basic telephone service to rural areas and has repeatedly demonstrated how the ordinary telephone can be transformed into a powerful educational tool at a marginal cost through the addition of simple audioconferencing equipment.

For the last six years, the RSP has explored the potential of satellite-based telecommunications systems as a means of providing relatively inexpensive rural telephone service, sharing scarce expert resources, and expanding educational opportunities to remote and rural areas. In the Pacific region, RSP undertook two major field projects in Peru and Indonesia. The Rural Communications Services Project in Peru linked six towns in a remote Amazonian river basin with the domestic telecommunications system and provided basic telephone services for the general public and audioconferencing facilities for agriculture, health, and education programs. The Indonesian Distance Education Satellite System connected ten universities in a program of resource-sharing for course delivery, staff development activities, and administration. This report describes both of these projects and their different approaches to utilizing telecommunications services for the development of rural and remote areas.

PERU RURAL COMMUNICATION SERVICES PROJECT

BACKGROUND

Like many developing countries, Peru has experienced a steady decline in economic conditions over the past decade. In fact, the last 20 years have seen virtually no growth in the per capita gross domestic product. Faced with economic and social crises, the Peruvian government has emphasized the development of its vast rural areas in an attempt to increase lagging agricultural productivity. By opening up new production areas in the promising "high jungle" areas, the government hopes to redress existing food shortages and unfavorable agricultural export balance.

The Department of San Martin, in the isolated upper Huallaga Valley, has been the focus of agricultural expansion efforts. Very much a frontier area, San Martin is geographically separated from the commercial, political, and scientific centers of coastal Peru by the Andes. The absence of essential infrastructure and communication services--such as roads, transportation, postal and telephone systems--has conspired to compound the isolation and retard the social and economic development of the region. In short, San Martin has had little access to information essential to the development process--agricultural workers remained ignorant of new cultivation techniques, farmers had little means of acquiring market information and purchasing needed farm inputs, commercial transactions were limited to regional marketing centers, medical care relied solely on existing professional resources and educational and training opportunities were non-existent.

In keeping with Peru's rural sector initiative, the Peruvian telecommunications company--Empresa Nacional de Telecommunicaciones (ENTEL)--has explored ways to extend basic telecommunications services to rural areas. Under a cooperative agreement between USAID and ENTEL, the Peru Rural Communication Services Project (RCSP) was developed to integrate satellite communications into the process of rural development.

RCSP

The RCSP is based on the premise that basic telephone service is an effective means of overcoming infrastructure and resource limitations and constitutes an essential component in the development process. Under the RCSP, telephone service was provided to seven strategic rural communities ranging in size from 800 to 15,000 inhabitants, thus linking them with each other and with the rest of the country through the national telephone network. Building on the basic telephone system, audioconferencing facilities were developed to serve the health, education, and agriculture ministries. By linking field and extension personnel with regional and central ministry headquarters, audioconferencing improves the operations and outreach of these centralized institutions. The geographically isolated agricultural extension agents, health care workers, and teachers of the San Martin region benefit from improved access to Lima-based specialists for in-service training and consultation; the ministries now have a means of expediting administrative procedures, coordinating programs, and supervising staff. Overall, enhanced communications supported by the audioconferencing network make both the field personnel and Lima-based bureaucrats more responsive to each other's needs and consequently more effective in their work.

Management responsibility for the RCSP rests with ENTEL. As the national telecommunications authority, ENTEL is in charge of telecommunications and broadcast signal delivery, including telephone, television, telex, etc. The basic telephone service component of the Project naturally falls within ENTEL's domain, as does the operation of the teleconferencing network. However, in a significant departure from its traditional commercial service orientation, ENTEL also has assumed responsibility for the development and coordination of the audioconferencing service, including programming as well as technical system maintenance. To carry out the social service objectives of the Project, ENTEL established an "applications planning" unit charged with promoting, implementing, and evaluating appropriate communications programs which support the activities of the user groups. This includes needs assessment, program presenter identification, scheduling, and materials distribution. Ongoing engineering assistance was provided by ENTEL engineers assigned to the Project. However, as both the public telephone and audioconferencing services were routinized, engineering responsibility has been integrated into standard ENTEL operations with primary technical responsibility becoming that of the local ENTEL public call services staff.

Telephone System and Audioconferencing Network

The primary technical goal of the RCSP has been to develop the most efficient, cost-effective means of extending basic telephone service to the San Martin region in order to provide a blueprint for future expansions of ENTEL's rural communications system. Innovative adaptations of equipment and new network configurations characterize the RCSP technical system. The three larger towns of Juanjui, Toache, and Saposoa were equipped with modified four SCPC channel earth stations and power generators; the four smaller communities--Pachiza, Huicingo, Bellavista, and Tingo de Saposoa were connected to the telephone system through VHF radio links bridged at the Juanjui earth station. Simple audioconferencing facilities were installed at ENTEL offices or municipal buildings at the seven sites as well as at ENTEL offices in the commercial centers of Tarapoto and Lima.

As part of the effort to reduce capital costs, the standard earth station design was modified in three ways. First, 6.1 meter earth stations, never before used with INTELSAT domestic service, were specified as part of a calculated risk to conserve costs. Second, the earth stations were designed to be non-redundant on the premise that rural telecommunications could forego some reliability if system costs could be significantly reduced. Third, system installation would be conducted by ENTEL under manufacturer supervision, thus forgoing the "security net" of a turnkey contract and the increased costs associated with such an arrangement. Following installation, ENTEL was able to reduce the number of satellite circuits required by the new telephone system from ten to two, by placing the audioconferencing bridge in Lima.

Further cost savings were effected by the use of BUDAVOX radio equipment for the secondary site links, which Peru had acquired in a barter arrangement with Hungary.

Three years following initial installation efforts, the telephone network and audioconferencing system operate with high technical reliability: in 1985 the earth station sites experienced 365 days of uninterrupted service and only four percent of the audioconferences were cancelled because of technical reasons.

However, as with most new and sophisticated communication systems, it has experienced its share of start-up difficulties. During the first 18 months of operation the number of service interruptions was quite high due to modem and transmitter burnout, instability of the INTELSAT IV-A satellite and inadequate tracking indicators, and, of course, technician and operator unfamiliarity with the new system. A major disappointment has been the performance of the radio links. Due to the erratic performance and frequent breakdowns of the unreliable and acknowledgedly poor BUDAVOX equipment, the radio-linked sites were seldom able to participate in the scheduled audioconferences. ENTEL eventually decided to discontinue audioconferencing service at three of these sites and place the equipment in other locations with reliable telephone service.

Finally, many of the telephone system's problems were caused by its popularity. The unexpectedly heavy demand for rural telephone service overburdened the telephone system, resulting in equipment breakdowns, insufficient spare parts to service the system, inadequate power supply, inadequate channel capacity, and long lines at the public call offices. ENTEL has responded by increasing channel capacity, reconfiguring the system to route radio link traffic through the least used earth station, and automatic switching at the regional ENTEL office.

Development Applications

The key objective of the RCSP was to demonstrate the potential of rural telecommunications to serve as a catalyst for development and support sector-specific activities. The RCSP focused on both the role and uses of basic telephone and audioconferencing service in the rural sector.

1. **Basic Telephone Service:** In late 1983 telephone service was inaugurated at the three primary sites; a few months later the radio links were established at the secondary sites. At each of the seven sites, ENTEL established public call offices equipped with call boxes, which operated from early morning until late evening. Public call service is provided in two ways--telephone calls sent/received and telephone messages sent/received. Public calls are initiated at the ENTEL offices by placing a request with the operator. These requests are arranged sequentially, awaiting an open channel. The individual must wait at the office until his call is successfully placed or cancelled. A similar procedure is followed to receive a call.

Because most receivers (and initiators) of calls do not have home telephones, ENTEL developed a telephone message service to prearrange calls between two public booths or between a private phone and a public booth. When a message arrives in a community, ENTEL delivers it to the recipient's home or work place. These messages are quite brief, indicating merely that the recipient should be at the ENTEL office at a specified date and time.

Within months of service installation, the telephone service was used to capacity. In the first six months of service nearly 5,000 calls were completed per month over the system, ranging from 1,890 calls at the largest community to 39 calls at the smallest. This heavy traffic resulted in congested lines and long waits at the telephone office, with the radio-linked communities often losing precedence to customers at the earth station sites. The following year ENTEL added two additional channels per earth station. By 1985 the average waiting time to complete a call was 50 minutes, 74.3 percent of calls were completed, and traffic had risen to over 11,000 calls per month. In 1985 the telephone system produced over US $134,600 in revenues.

Contrary to expectations, the addition of the channels did not serve to reduce waiting time or improve completion rates. These two problems, in fact, worsened. Although more traffic was accommodated with increased channel capacity, the system was still overburdened by the ever-growing demand for telephone service.

Over the past three years of service, certain usage and user patterns have emerged. Initiated telephone calls have dominated the RCSP traffic. More than 93 percent of the calls are made from the network sites to locations outside the network

(48 percent were directed to Lima); however, approximately 20 percent of the calls from the remote radio-linked villages are to the larger earth station communities. In general, there is little receiving activity. The average call lasts about six minutes and costs about $.75 US. This amount represents 0.5 percent of monthly family income ($153 US), a relatively high sum.

The "penetration" of telephone usage is high. Nearly two-thirds of the area's families have used the telephone system. The system's utilization rate equaled about 2,561 calls attempted per 1,000 residents. The average number of calls per user is 4.6 per month. Telephone is the preferred means of communication: users indicated that on the average they sent 1.8 letters and 0.6 telegrams per month, and made 1.4 trips to Lima and 4.4 trips to the regional commercial center of Tarapoto per year.

Furthermore, in the years following the initiation of telephone service in San Martin, users have indicated heavy reliance on telephone and telegram service and preference of other communications means, particularly mail, declined dramatically.

Seventy percent of the telephone users used the system for personal reasons, 27 percent for business, and 2.5 percent for both. However, the "commercial" users were by far the heaviest users: 45 percent of the commercial users placed over five or more calls a month, compared with 23 percent of the "personal" users. In fact, commercial users exceeded average use by 24 percent. Clearly, the telephone system is used to facilitate business and commercial activities in the region.

Although it was originally envisaged that telephone service would be limited to public call boxes and possibly made available to local sector offices, not long after system initiation ENTEL made available private subscriber service to homes and businesses, as well as government agencies, at the primary sites. The private subscriber service tended to alleviate pressure on the public call facilities, and, not surprisingly, the completion rate for "private" calls was less than that for "public" calls. Although private users did not wield the same influence on harried operators as the public call customer, the long wait for completing a telephone call was not as onerous. Telephones were installed about equally in private residences and businesses. The original plan to install telephones in sector offices was not implemented because of the high cost of running lines to community clinics, schools, and extension facilities and ENTEL's reluctance to provide free telephone service to the individual ministries. However, several health administrators, quick to realize the value of telephone communications in their work, allocated funds from their own budgets to pay for telephone installations in zonal hospitals and clinics. The agriculture and education sectors, lacking discretionary funds, relied on the audioconferencing network

2. **Audioconferencing Service**: The operations and development efforts of the social service sector in San Martin were severely handicapped by:

- inadequate access to information required to develop and provide effective services,
- lengthy delays in handling routine administrative matters,
- lack of staff supervision, and
- absence of in-service training programs for field workers.

The audio conferencing component was developed to support and strengthen these rural institutions. Audioconferencing facilities, consisting of a convener and push-to-talk microphones, were established at each site, either in the ENTEL office itself or a central municipal building. Targeted users were the field staff of the health, agriculture, and education ministries, including administrators and service personnel such as teachers, doctors, nurses, other health care workers, extension agents, etc. At each site a representative from each sector was designated "local coordinator" to work with ENTEL in identifying sector needs and organizing appropriate programs. A monthly schedule was developed detailing sector programs, participating groups, dates and time, and coordination responsibilities. The schedule was distributed at the beginning of each month to enable field workers to prepare for audioconferences.

Over a two-year period (1984-1985), 658 audioconferences were conducted--266 in 1984 and 392 in 1985. Over 80 percent of the approximately 900 sector personnel in San Martin participated in the audioconferences.

Initial reaction to the audioconferences was enthusiastic. However, technical problems with the new telephone system, as well as the audioconference management system, resulted in a 37 percent program cancellation rate. The radio-linked sites were rarely able to participate in audioconferences due to technical difficulties. Failure of coordinators or presenters to appear on time or at all discouraged those who had taken time to attend the conferences. Participant and presenter unfamiliarity with the interactive technology resulted in lengthy (78 minutes) and tedious conferences.

However, in 1985 improvements in all aspects of the audioconferencing system, programmatic as well as technical, rekindled user interest and confidence, and network use and management settled into a routine pattern. The cancellation rate fell to 29 percent, a dramatic 41 percent decrease from the previous year. Better network coordination and understanding of user needs lowered last-minute cancellations substantially, although general strikes periodically disrupted all sector activity and the erratic services provided by the radio links virtually excluded the secondary sites from participation. Improved network management also responded to user schedules. Previously scheduled between 9:00 a.m. and noon in order to free the telephone channel for commercial use, the 1985 audioconferences were shifted to lunchtime to accommodate health sector personnel, late afternoon for teachers, and Fridays for agricultural workers (the day set aside for office tasks). The management system relied less on rigidly planned monthly schedules to allow for "unscheduled" (less than six weeks in advance) conferences, which grew to 31 percent of total conferences.

Growing familiarity with the medium improved the quality and content of the audioconferences. Start-up delays were reduced to 15 minutes, and the average conference session lasted 54 minutes. Support materials were prepared and distributed more regularly, although postal and distribution services continued to cause problems.

The number of audioconferences increased in 1985 in all sectors except health, which was most adversely affected by the elimination of three radio-linked sites from the network. Average attendance per audioconference grew in every sector except agriculture; total enrollment, including repeat users, was 10,000 person sessions. In 1985 ENTEL itself discovered the utility of the audioconferencing network for training and management and consequently added its regional headquarters in Iquitos to the network. In fact, ENTEL use accounts for 33 percent of network use. Based on sector demands and requests of its own staff, ENTEL intends to move the decommissioned audioconferencing equipment to other regional communities.

Network use in 1985 was predominately for in-service training, which accounted for 64 percent of all sector and ENTEL programs. Administrative use fell from 30 percent in 1984 to 12 percent in 1985. This shift reflects user preference and need for in-service training, as well as frustration with administrative conferences which consisted mainly of directives communicated from ministry headquarters in Lima. With the emphasis on in-service training, Lima gained increased precedence as the originator of audioconferences. Indicating that regional experts were inferior to Lima-based authorities, sector participants expressed a strong preference for more centralized training programs. RCSP staff in Lima responded by recruiting the best qualified presenters--both within the central ministries and from other institutions and universities--to meet the growing demand for distance training. Although some programs continued to originate from regional headquarters of Tarapoto, there was little reliance on and interaction among local resources.

The health sector was the most competent and innovative in its use of the audioconferencing network, reflecting perhaps greater congruence of its communication and information needs with the service provided by the RCSP. Unfortunately, because of persistent non-performance of the radio links, the medical consultations to the most remote communities had to be cancelled. Clearly one of the most service-oriented activities, these distance diagnosis and treatment programs are an important rural service and enjoyed great popularity during their short tenure.

However, other health programs flourished. To gain access to Lima-based specialists, an ongoing training program was developed with the Colegio Medico in four areas: internal medicine, pediatrics, gynecology and obstetrics, and primary health care. These conferences were well received by the participating doctors, nurses, nurses aides, and community health workers. Over a ten-month period, total attendance reached over 1,100. The RCSP network was also used to support the National Vaccination Campaign--for coordinating logistics, training workers, monitoring progress, and evaluating results.

The education sector conducted the greatest number of audioconferences. The network became the means of delivery for 32 workshops conducted by PROMULCAD, an innovative teacher training program. Special education was also a sector focus. A series of audioconferences were developed on learning disabilities. So successful were the programs that local parents asked to attend, and eventually, in an innovative mixed media event, audioconferences were broadcast live over the local radio station and questions entertained through a "call-in" arrangement. Using new diagnostic tools gained through the audioconferences, the teachers were able to document local needs and successfully petition for the establishment of a regional treatment center.

The agricultural sector was least able to establish a viable audioconference program in San Martin. Plagued by strikes, poor leadership and management structure, only 88 audioconferences were completed in 1984 and 1985. Furthermore, the farm-visit strategy promoted by the ministry prevented extension workers from regularly attending audioconferences. However, in 1985 the new training orientation and revised schedule helped to increase the number of successful audioconferences by 57 percent.

What has telephone and audioconferencing service meant to rural San Martin? Rural telecommunications networks have had a powerful impact. The telephone service has been expanded twice; it has sustained a strong and growing demand, used by many people with relatively low incomes; it generates sufficient revenues to be partially self-financing.

At a marginal cost, the audio conferencing system supports many innovative applications and enjoys high public sector demand, as well as promising viable commercial use for the private sector. Over 92 percent of the audioconference participants indicated the programs improved their skills and job performance, and 55 percent responded that without the audioconferencing service they would be unable to obtain essential information and training. The network's popularity with rural workers is attested to by official letters to ENTEL requesting it to continue service after formal RCSP conclusion, even if they must pay for the service.

Based on the RCSP experience, Peruvian development agencies have for the first time made telecommunications a priority investment for rural areas. CORDES, the rural development agency, has agreed to contribute US $45 million to extend telecommunications service to 700 rural communities over the next five years. ENTEL itself has developed a plan to expand service to the Andean Trapezoid area and provide audioconferencing service. Rural communications in Peru has achieved recognition and credibility as a catalyst for development.

SISDIKSAT: THE INDONESIAN DISTANCE EDUCATION SATELLITE SYSTEM

BACKGROUND

Higher education in Indonesia is now facing a number of challenges that require innovative responses. Years of heavy investment in primary and secondary education have greatly increased the number of high school graduates. Each year nearly one-half million graduates compete for fewer than 100,000 openings at the 43 government-supported institutions of higher learning. The 400,000 "losers" must look for places at inferior private universities, wait for next year's exam to try again, or give up their goal of a college degree.

Indonesia's rapid economic growth and expanding need for trained manpower add increased urgency to the demographic imperatives. The existing colleges and universities are unable to meet the demand and fulfill the nation's needs due to a number of limitations including manpower and financing, low productivity rates, and the extremely uneven development of these institutions. Widely scattered across Indonesia's many islands, they also face the limitations of growth based on self-reliance.

In 1976 Indonesia became the first country in the developing world to launch its own satellite--the Palapa A-1--and to develop a satellite-based communications network which has been crucial in linking the thousands of islands comprising the 3,000 mile-long Indonesia archipelago. A decade later Indonesia is again in the vanguard as it pioneers an innovative project utilizing its telecommunications capacity to meet its development objectives.

Under an agreement between USAID and the Directorate General of Higher Education of the Ministry of Education and Culture, the SISDIKSAT Distance Education Project was created to meet the challenges of increasing the opportunities for and quality of university education.

SISDIKSAT

The SISDIKSAT Distance Education Project was designed to maximize the scarce professional and teaching resources of the Eastern Islands Universities Association, a group of fairly new universities and teacher training colleges on the islands of Kalimantan, Sulawesi, Maluku, and Irian Jaya. Linking ten distant and remotely-located universities with a telephone-based "electronic classroom," SISDIKSAT is used to provide rarely available academic courses to university students, upgrade faculty knowledge and teaching skills through in-service training programs and seminars, and facilitate administrative and institutional communication. Its effect is to make the expert resources of one university available to the other participating universities, thus multiplying each professional's outreach and effectiveness. Also included in the SISDIKSAT system are the Java-based Bogor Agricultural Institute--Indonesia's premier agricultural university--which serves as a center of excellence, and the Directorate General of Higher Education, which is the bureaucratic headquarters. SISDIKSAT's main activities are course sharing, seminars, audio-conferences, training programs, message service, information exchange, and demonstrations which often include other user groups outside the university community.

(One example of this is the "electronic classroom" installed in 1985 in conjunction with a small solar-powered earth station located in the remote area of Wawatobi which will serve the agricultural research station and local extension workers.)

SISDIKSAT is managed by a core staff at the central project office in Ujung Pandang with locally appointed staff at each site. At project headquarters, the staff consists of a Project Administrator, a Program Coordinator and a Chief Technician with a few support staff. It is important to note that all of these positions are part-time, filled by local university personnel in addition to their regular teaching and professional duties who receive little in way of recompense. These personnel are responsible for the planning, administration and management, and technical operation of a 13-site system which spans 2,500 miles of ocean and offers more than 15 courses a semester.

TECHNICAL SYSTEM AND ELECTRONIC CLASSROOM

SISDIKSAT is a fully interactive (i.e., two-way) communication network, utilizing two dedicated voice channels on the Palapa satellite and a four-wire ground telephone system. It consists of an audioconferencing channel with loud-speakers and 12 microphones in classrooms seating from 40-80 persons. A second channel is used for a number of purposes: facsimile transfer, private phone conversations, telewriting via a graphics system developed by the British Open University, and as a back-up channel. Each site is also equipped with auxilliary power supply units to meet frequent power outages.

System design, procurement, installation and burn-in took place over a two-year period (far longer than anticipated) and resulted in several technical innovations designed to limit costs and enhance reliability. Unlike other conferencing systems using a terrestrial bridge to link multiple sites, SISDIKSAT uses the satellite itself as a bridge in a "loopback" (half-duplex) design. Although only one site can talk at a time, it reduces the number of channels that need be leased. At a range of $125,000-$190,000 per channel per year, the cost-savings is significant. However, one disadvantage is that line noise originating from one site can automatically be passed to all other sites. To prevent this, a "gating" system was placed between the classrooms and central telephone exchanges at each site. A signal from the transmitting classroom closes the transmit circuits at the other end of the local telephone line thus preventing the transmission of line noise and other localized disturbances to the entire network. In areas where electrical storms are frequent and local lines are normally poor, this device greatly improves the audio quality throughout the system.

The issue of maintenance and repair of the equipment has also been tackled. Although technical training and extensive spare parts have been provided, logistics and manpower continue to be a problem. Getting a failed piece of equipment to SISDIKSAT headquarters takes coordination and money, and once at Project headquarters, repair takes time and skills that are at a premium. More than sophisticated technical skill and knowledge, the technical system requires vigilant management and a small, but full-time, cadre of technicians to ensure all equipment at each of the 13 sites is in good operating order.

Despite these problems, the technical system has performed very well throughout the past year. Only 2.5 percent of SISDIKSAT program activities have been cancelled due to technical problems between August 1985 and the present. (This excludes the one percent down-time due to the Palapa satellite's unprecedented move out of orbit in September 1985.) However, this 98 percent reliability record of the audio capacity does not extend to the graphics transmission. Although the facsimile component works well, the telewriting equipment has proved disappointing. Its poor performance record is due to several factors: overly complex design, susceptibility to climatic conditions, demanding technical oversight, and extreme sensitivity to line noise--a virtual given of the Indonesian phone system. Its function has therefore not been incorporated into regular SISDIKSAT activities, with apparently no ill-effect on the system"s pedagogical effectiveness--contrary to the earlier claims of teachers that visual capabilities were essential.

PROGRAMMING

In October 1984 SISDIKSAT initiated a trial semester offering two courses; it is currently completing its fifth semester with a regular schedule of 15 courses. To date it has delivered 60 undergraduate courses such as statistics, research methods, poultry production, and forestry. Use extends beyond normal course delivery to other activities including training, faculty seminars, and administrative conferences and to other user groups. The Open University uses SISDIKSAT for regular in-service training for its local tutors in the eastern islands and for administrative communication with its provincial offices. The Directorate General of Primary and Secondary Education is now launching in-service training for its teachers. Other groups such as the Summer Institute of Linguistics and the Bogor Graduate Agriculture Program use the system for weekly management meetings. Initial problems of attendance and regularized use have diminished as both the users and SISDIKSAT management staff become more familiar with operational procedures.

Course Delivery and Attendance

SISDIKSAT emphasizes primarily a three-pronged course exchange program among its members. SISDIKSAT develops course materials in the national language, delivers courses for at least two semesters to meet the short-term needs of its members, and works with junior faculty so that they can teach the courses in the future without SISDIKSAT. Courses are selected over the system by participating institutions" representatives--generally the Vice Rektor for Academic Affairs--based on need and resource availability. Both the courses and the course teams are identified at the same time, and the sites indicate which courses they will follow. No site has yet participated in all courses; no course has yet been taken by all sites. The three-person course team prepares the written materials and/or study guides with assistance from SISDIKSAT staff. SISDIKSAT reproduces the materials and distributes them to the participating campuses. The course team shares the instructional responsibilities over the system (generally 100 minutes per week) while local tutors at each receiving site supervise students, lead local discussions, administer and correct tests, and generally serve as the arms and eyes of the distant lead teachers. Course credit and grades are given by the local institution, not the offering site.

Of the 60 courses delivered so far, 29 have been extensively monitored. SISDIKSAT classes have averaged 97 minutes per week with 31 minutes for student questions and teacher answers. This compares very favorably with a survey of regular on-campus classes that lasted only an average of 65 minutes with only 4 minutes for student questions and teacher answers.

Uneven student attendance from week to week and semester to semester has been a problem. Attendance has ranged from 1,500 a week in the February 1985 semester to 2,600 in the September 1985 semester. Attendance varies because of holidays, the courses offered, and the timing of the semester. Many of the SISDIKSAT institutions have slightly different academic calendars, thus making a coordinated semester almost impossible. Most sites have at least one local tutor supervising the satellite class, but in some instances 3-5 faculty members are present for the classes. Many of these faculty members attend classes on their own to learn more of the content of the course and see how it is taught by an expert. In fact, SISDIKSAT specifically reserves one half hour per week following the regular class session for meetings between the faculty and lead teacher as part of its teacher upgrading program.

Both student and faculty figures show substantial attendance during a 12-week core period when all participating universities are functioning full time. Attendance traditionally is low during the initial and final three-week periods of the semester largely due to the different starting and ending dates of the universities. For example, the September 1985 semester began with a disappointing turnout of 200-300 students and 40-50 faculty. However, this number grew until it reached a peak of 3,085 students and 92 faculty in week 11 of the semester. The next semester began with approximately 900 students, reflecting a better match with the schedules of many institutions.

SISDIKSAT was able to deliver 83 percent of its scheduled class sessions in 1985-86. Less than three percent of classes have been cancelled because of technical problems.

In contrast with the low failure rate of the technical system, failures in the "human" system accounted for 88 percent of the class cancellations. The main hindrance to course delivery was teachers failing to come to class at the proper time (51%), followed by the absence of teachers and students at class time (20%) and the absence of students (17%). Although student absence was mainly confined to the first weeks of the semester, teacher absence was a common occurrence throughout the semester. Only 13 of the last 24 courses did not have any cancellations due to teacher "no-shows."

For an explanation of these course delivery patterns we must look to standard Indonesian university practices. First, among the participating BKS universities there is no standardization of the academic calendar, which creates considerable confusion in coordinating a ten-university project. Even at individual institutions the starting times are a bit murky--it oftens transpires that the first month of a semester is spent on organization and producing a class schedule.

Further, little emphasis is placed on class attendance, as attendance records are neither kept by the teacher nor seem to figure in the final grade. Finally, tremendous latitude is exercised by the teachers over what, when, and how they are going to teach. They are free to cancel classes at will and re-schedule them. The students seem to have little say in the matter; nor do interviews reveal that they are unduly disturbed by these capricious scheduling practices.

Use and Participation

The SISDIKSAT schedule is almost fully booked from 8 am to 5:00 pm for courses and training. In actuality, network use starts two hours earlier with administrative conferencing between the three universities in the eastern time zone, and continues into the evening with specially requested courses and Open University use. However, nearly every week sees some discrepancies between what was planned and what actually happens.

Primary use is for "course delivery": 35.8 percent of use was devoted to this activity during the last two semesters. Optimum use, based on the scheduled 100 minutes per class, calls for 44.8 percent of SISDIKSAT prime time (8:00 am to 5:00 pm). Cancellation of classes and failure of teachers to fully utilize the allotted time accounts for this lower figure. There was also a great shortfall in the utilization of a half hour per course designated for tutor meetings. The tutor-teaching meetings are important to SISDIKSAT's teacher upgrading program, and omission lessens the anticipated "multiplier" effect. However, 100 percent of 40 tutors surveyed said that their SISDIKSAT experience improved their ability to teach similar courses. Eighty-six percent said they increased their knowledge of the subject area even without regular tutor meetings. "Silence" accounted for 17 percent of SISDIKSAT time which corresponds to the discrepancy between scheduled and actual course delivery. This includes silent periods during and between programs as well as the time that it is not being used at all. SISDIKSAT administration and technical management used 19 percent of system time, while official university business, meetings and messages constituted 27 percent. Most of these conferences, however, occur informally. With the exception of the three aforementioned universities no group within the Directorate General of Higher Education other than the Graduate Agriculture Program uses SISDIKSAT for regular administrative meetings. Finally, seven percent of system time is used for private message transfer. University personnel were quick to realize its economy in communicating with distant areas.

Although these activities do not figure in the usage statistics as they engage after-hours or semester break time, SISDIKSAT provides service to the Open University of Indonesia and presents a seminar series. The Open University meets up to ten hours per week for tutorial and course development purposes. The SISDIKSAT seminar series is designed primarily for faculty members with the goal of promoting information, research, and intellectual exchange. Although aimed at university personnel, other local institutions such as the health and agriculture departments have participated in the monthly seminar series. In January 1986 the semester break time was used to present a series of 24 two to three-hour seminars which attracted over 1,200 participants. As attendance was voluntary, the implication is that a need and demand exist for this service. Of the 604 participants surveyed, 99.8 percent requested that SISDIKSAT continue to deliver seminars. Over 97 percent found the programs useful and interesting.

Is there a demand for SISDIKSAT? A review of site participation indicates that there is. Most universities sent a substantial number of students to SISDIKSAT courses, but highest attendance is credited to the most isolated, distant, and youngest institutions. The two eastern-most campuses account for nearly a third of the SISDIKSAT students. These two campuses also regularly use off-hour system time for administration and "purchase" special courses for evening presentation, basically using SISDIKSAT over a 12-13 hour period per day. Two other universities have "outgrown" their SIS-

DIKSAT classroom facilities and have expanded or added classrooms. Three sites have been added to the 12 originally installed: one university, one teacher training institute, and the central office of the Open University.

In general, the lowest and weakest attendance accrues to the largest and best-staffed institutions in the SISDIKSAT network. Not surprisingly, they view themselves as sources of expertise and course presenters, rather than needful recipients. Indeed, the other universities are eager to receive courses originating from these sources and they are always well attended. Evidence indicates, therefore, that SISDIKSAT is useful and convenient for the larger universities; it is essential to the smaller and remote campuses.

The response of undergraduates to SISDIKSAT has been somewhat ambivalent. Although the vast majority of those surveyed thought that SISDIKSAT teachers and materials were as good or better than local resources, that audio quality was good, and that classes were well-run with sufficient time for participation, a majority also expressed their continued preference for locally taught courses. Only 20 percent said that they preferred taking a course via satellite, and 31 percent believed that they learned less in a SISDIKSAT course than in a regular course. (Ninety-five percent of their local tutors felt that they learned as much or more via satellite.)

This ambiguity results from several factors. First, there is the natural human preference for face-to-face interaction--particularly strong among Indonesians. Also, occasional technical problems and poor soundproofing in some classrooms may have alienated some students. There are probably also some students who are not very interested in high quality instructors and materials. The may prefer a locally produced 50-page text to a SISDIKSAT-produced 300-page text. Objectively, the students are saying that the satellite courses are very good; emotionally, they are saying that they still feel more comfortable with their regular system.

This response is one indication that audioconferencing programs may be more suitable for more mature learners who have clearly identified learning needs and recognize the value of outside expertise. Such people are more likely to look beyond the delivery system and base their opinions on the value of the information they receive. Upperclassmen, graduate students, and, especially, professional people may be a more responsive audience for this type of system.

The overwhelmingly positive evaluation results from data collected from 846 of the seminar participants seem to support this idea. Ninety-nine percent of those participants found the seminars "very useful" and requested more. Over 92 percent found them "very interesting." Similar high percentages were positive about the supporting materials, degree of interaction, and format of the programs. These seminars seem to have struck an area of great need among professionals in remote areas. Participants included personnel from off-campus groups such as the health, family planning, and agriculture sector. Additional positive feedback has come from the Open University tutors getting in-service training over the system and from local SISDIKSAT tutors. Many professionals have suggested that SISDIKSAT give graduate courses for working professionals. The area of in-service training is potentially one of the most powerful uses of such audioconferencing systems. The need exists in all countries. The potential audience is very receptive. SISDIKSAT and the RCSP have shown that it can be done.

LESSONS LEARNED

The Rural Satellite Program promotes an innovative idea; its pilot projects were the first efforts in testing the technology/methodology developed under the Program. Establishing a rural telecommunications network requires tremendous effort; establishing a distance instruction program in the developing world, where the vicissitudes and vagaries of the climate, environment, and infrastructure make daily life a challenge, at times approaches the overwhelming. Over the past five years, a tremendous amount has been learned about the planning and implementation of satellite-based projects, from the minutia of equipment procurement and technical design to the grander theories of distance education and development. The basic tenets about the need for strong institutional support, sound management, and dynamic leadership still stand. The following are just a few of the lessons from the AID Rural Satellite Program.

Technical

1. Everything takes more time than anticipated. The planning of a rural system, purchase of equipment, shipping, testing, installation, and initial shake-down period can take several years. The basis of a sound technical plan is an accurate initial baseline survey of the existing resources and, in the case of an audioconferencing network, the telecommunications system itself. Pay particular attention to the quality and stability of your local lines. The 44,600 miles up to the satellite and back probably will be less of a problem than the last mile of cable that links your classroom to the satellite network.

2. In choosing equipment, start simple and make it more complex only if the staff, time, money, and skill are available to support it. The capabilities of the equipment, of course, should correspond to the needs of the activities and staff who will be using it. One of the program's main technical problems has been with the highly complex and delicate graphics system that has been subject to hardware problems, interference from poor quality lines, and lack of proper maintenance and operation procedures. Problems with a secondary but glamorous piece of equipment can create a negative attitude toward the entire system, even if the basic audio system is functioning well. The idea

of teaching with a solely audio system worries instructors; initial planning surveys find most teachers stressing the absolute need for graphics equipment. These statements should not be taken at face value. Close observation of regular face-to-face teaching methods should be made. It could reveal that visual and printed materials are not a fixture of regular teaching practices--as in Indonesia--and the need for graphics is not as immediate as perceived.

3. Technology-based projects generally start off with the good intentions of avoiding concentration on the hardware at the expense of the software. When the inevitable problems occur during testing and installation, all attention becomes riveted on "getting the thing to work" and less priority is given to the actual activities that will be undertaken when the system does work. It is also a sad fact that funding is often more easily found for the purchase of new equipment than for the operation, maintenance, and repair of existing equipment. However, this "actuality" does not lessen the very real need for ongoing support of the technical system. As the foundation of the programming activities, its reliable performance is essential. "Economizing" in this area can cause fundamental problems. The program's technical systems require more manpower than spare parts, a requirement more easily met in the developing world.

Planning

4. Accurately assess the stages of growth and maturity of the user institutions before creating an implementation plan. A major challenge of the Indonesia Project has been to reconcile the actual educational practices of the universities with the requirements of distance education. Do not assume that the basic pedagogical methods of higher education in the developed world are in place in the developing world. In Indonesia, particularly, SISDIKSAT found itself grappling with such basics as getting the instructors to come to class regularly, determining if they had ever developed a curriculum for their face-to-face classes, ascertaining whether textbooks actually existed and if they were in a language the students could understand, before focusing on the more "esoteric" needs of distance education such as course adaptation, study guide development, and interactive teaching techniques.

5. Do not assume that an existing institution or association of institutions implies common needs among its members. Nor should need be confused with demand. In the Peru Project, it was originally anticipated that the Lima-based ministries were eager to communicate with field personnel in facilitating administration and management. Although field workers were enthusiastic, central ministries were reluctant to avail themselves of a two-way network whereby field personnel could respond to and question central policy.

6. Do not assume standard administration practices or structure are present at all participating institutions. A continuing management problem for SISDIKSAT has been the lack of standardization among the universities which causes conflicts in essentials such as semester start-up, testing, etc. Further, the management needs of the distance teaching program may be incongruent with management practices of the institutions. For example, remuneration for course development in Indonesia is predicated on the production of textbooks or modules; SISDIKSAT requires study guides. It has been difficult to convince the course teams to produce study guides when compensation depends on textbook development.

Implementation

7. Although telecommunications can provide a reliable link between members of a group, it does not solve any existing problems of the coordination and organization of that group. It is a major task for SISDIKSAT to get 10 institutions to agree upon programming. The RCSP could not overcome the shortcomings of sector organization, as evidenced by the agricultural sector. A strong organization is needed at the center of the network to coordinate, mediate, and implement the proper policies and procedures that will ensure a smooth-working, highly efficient telecommunications network. This requires officially mandated authority, strong and competent leadership, and--very important--readily accessible budget.

8. The introduction of an innovative system does not automatically mean that the users will adopt innovative ways of utilizing such a system. A major effort must be made to get users to take advantage of the new capabilities and limitations facing them. You have to work for incremental change. Faculty members who have been lecturing for years will not immediately see that it is more effective if periods of 10-15 minutes of lecture are interspersed with interactive periods that involve the students. Providing users with a telewriting/graphics capability does not automatically ensure that they will use it or use it well. There must be staff members trained in interactive audioconferencing who are available to work with users of the systems and gradually get them to expand and improve the ways in which they use the system's capabilities.

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*The data for the Peru Rural Communication Services Project were prepared by Florida State University. Particular credit for collection and analysis should be given John Mayo, Gary Heald, and Stephen Klees.

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SESSION 4

Applications of Small Aperture Earth Stations

VERY SMALL APERTURE TERMINALS - (VSAT)

An Overview

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1. Abstract

Very small aperture terminals are small, (1.2 meter) low-cost, (under $10,000), 2-way satellite earth stations that are beginning to have a major impact on communications networking. More powerful satellites and earth station technology developed for direct broadcasting are the basis for VSAT networks. Cost savings with a VSAT network can range as high as 50% over the cost of leased lines. In addition, costs are controllable and predictable over a period of ten years. The networks are highly reliable and offer flexibility with respect to the addition or relocation of sites.

2.0 NETWORK OVERVIEW

Very small aperture terminal technology provides either receive-only or receive/transmit terminals installed at geographically dispersed sites. Receive-only terminals and their networks are arranged in a "star" network. In the case of two-way terminals, the network topology is generally a star too since the VSATs must communicate directly with a master earth station commonly called the network hub.

The cost of the hub can be up to $1 million and that places a fully private VSAT network out of the reach of most organizations. Full service shared hub network offerings are being made available by carriers to those users that cannot afford their own private network with a hub.

This shared hub alternative has become very attractive to wide-area, thin route data communications networks. These networks can have hundreds or thousands of widely distributed terminals generating a small amount of data traffic. A few of the many situations falling within this category include hotel and airline reservation systems, retail stores and other franchise systems, banks, brokerage firms and insurance companies.

In most of these cases, the remote sites transact intermittently with host computers at a central site, although remote-to-remote communications is not precluded in some networks.

The traditional methods for handling these applications include leased-line, multidropping, telephone dial-ups; public or private packet-switched networks; and satellite point-to-point networks. These methods are not ideal for large, thin-route networks because of their heavy reliance on inefficiently used, expensive terrestrial circuits. The result is excessive and prohibitive recurring costs.

Certainly, all terrestrial circuits, including the "last mile loops" to the user, can be bypassed by placing an on-premises satellite terminal at each network node. Because the satellite is largely insensitive to the location of the dishes and the users require only intermittent data, the satellite channel can be shared by many users- probably hundreds- with proper networking. Sharing the satellite channel results in extremely important savings in the recurring costs of networks.

The ground-station hardware costs must be reduced too and the prime area for reducing cost is to make the stations very small with respect to antenna size and transmitted power. To be able to communicate in this way, a powerful hub station must be built and placed at the operational center of the network to produce a "star" network. With hundreds of remote sites and one hub site, the expense of the shared hub results in a substantial cost savings.

2.1 EVENTS AFFECTING VSAT NETWORKS

Why have VSAT networks not emerged earlier? Recent events and developments were necessary to make the technology practical.
ATT Divestiture: created a problem of control for large data network users. Formerly the user looked to ATT, now the user has to deal with as many as 100 telephone companies. This creates a real control problem for the user. With VSATs he can bypass the 100 telephone companies and ATT unless he chooses ATT VSAT services.
Terrestrial Network Costs: rose rapidly after the divestiture and users began to look for bypass techniques that were feasible.
Microwave product costs: dropped quickly as a result of efforts that developed in anticipation of the direct broadcast satellite. With the demise of DBS, Ku, and C band earth station components dropped as much as 10:1 in such areas as the low noise receiver.
Networking technology: development was fueled by standardization movements such as IBM's SNA and the CCITT Recommendation X.25. These standards enabled a large number of products to emerge which allows network designers the opportunity to design without having to create every piece of the network.

Network Control, bypass motivations, and technology developments have made VSATs emerge. Cost reductions have influenced the shape of very small aperture networks. A brief description of the types of Network Configuration follows.

3.0 NETWORK CONFIGURATION

There are four configurations possible in a VSAT network. These networks are shown in Exhibits 1, 2, 3, & 4.

The one-way shared-hub shown in exhibit 1 has a point-to-multipoint configuration. The customer's central host computer site braodcasts messages to the VSAT sites through the hub or master earth station, (MES). This type of network is used for corporate video networks too.

A two-way network is illustrated in exhibit 2. In this network, the VSAT remote sites transmit data to the MES which is connected to the customer host site. The customer host site transmits data to the VSATs. Several customer networks with their individual host computers, and VSATs could share the MES.

A point-to-point network is illustrated in exhibit 3. The VSAT sites communicate with each other through the MES.

In this case a double satellite hop is required.

A private interactive VSAT network is illustrated in exhibit 4. The diagram shows the MES located at the customer host site. Cost justified private networks require several hundred VSATs at disbursed locations.

3.1 VSAT DESCRIPTION

Very small aperture terminals are simple and shown in exhibit 5. The station includes an indoor electronics assembly, an outdoor electronics assembly, and a small dish antenna.

The indoor electronics is housed in a chassis containing most of the terminal's digital and IF electronics and performs the following functions:
Data terminal multiplexing and control: allows several user terminals to share the VSAT and follows the terminal"s protocol. Typical terminal support includes Systems Network Architecture (SNA) or bisynchronous cluster controllers, asynchronous terminals, automatic tellers, point-of sale terminals, etc.
Networking:(optional) allows a user to request a logical connection to any other host in the data network
Data packetization and control: provides an error-free channel by breaking the user data stream into smaller numbered packets. These can be retransmitted on detection of a lost or garbled packet.
Satellite channel control: determines when the station may transmit over the shared satellite channel and if a received message was addressed to the receiver's site.
Signal processing: performs the satellite modem functions and the forward error correction.

The outdoor electronics unit is an integral part of the antenna feed system or is attached to the dish support structure. The unit contains the terminal's RF electronics. For Ku-band systems, this is typically a 1 or 2 W uplink power amplifier and a 250° low noise block converter, (LNC).

VSAT antenna dishes for transmit/receive Ku-band networks usually measure 1.2 to 1.8 meters in diameter. These dishes with their mounting frames weigh from 100 to 250 pounds. Some manufacturers designs include ballast-supported nonpenetrating mounts which increase the weight to 600 pounds.

3.2 MES (Hub Station)

The hub station block diagram is shown in exhibit 6. It consists of the following major subsystem:

Antenna Subsystem:is generally 6 to 9 meters. The size depends upon a cost tradeoff between the satellite power usage and the antenna cost.

Transmit Subsystem: consists of upconverters and a 20 watt to 300 watt high power amplifier. The transmitter is designed so that it can saturate the satellite transponder.

Receive Subsystem:includes low noise amplifiers, generally GaAs FET amplifiers having noise temperatures in the range of 150 to 175 degrees Kelvin at Ku band and 70-90 degrees Kelvin at C band. Down converters are also part of the receive system and they are designed to change the frequencies of a single satellite transponder.

Modem Subsystem: are designed for asymmetrical data or video. Data modulation generally consist of a large outbound TDM carrier and several smaller inbound carriers for each network.

Digital Processor Subsystem: routes and controls all traffic and carriers. It routes messages to and from the network nodes, including remote sites, hosts and other switched networks.

Network Control Computer:is the network management facility through which monitor and control, traffic engineering, billing, and other network administrative functions are performed.

4.0 MARKET OVERVIEW

The VSAT market began when Equatorial Communications entered the market with its one-way C-Band Service. However, the Ku-band technology and pricing is largely responsible for the current growth and interest in the market. Several market research firms have published reports relative to the size of the market. Although there are discrepancies in their forecasts, they are in agreement that the potential for VSAT sites is largest in the financial industry, (Merrill Lynch, Prudential-Bache, etc). The next largest sector is the retail business with several large chain stores, including 7-11, K-Mart, Wal-Mart and Micro-Age Computer Stores instituting VSAT communications between their headquarters and their stores.

4.1 APPLICATIONS

The most appropriate application for VSAT networks are software delivery, realtime inventory management, sales and pricing between retail outlets and headquarters sites, travel and financial related services, hotel and motel management and video programming, automatic teller machines, electronic database delivery, computer time-sharing, and thin-route voice. Video broadcast has become popular for such applications as employee training, sales presentations, and product introduction.

4.2 Major Players

Within the United States, there is probably an over supply of vendors involved in the market development of VSAT networks.

Among the satellite carriers, American Satellite has a $4.2 million contract with Halliburton for a 120-site network. AT&T Skynet has several beta tests in process, Equatorial has one-way C-band systems with the New York and American Stock Exchanges, Dow Jones, Inc., the Associated Press, Reuters, Ltd., Commodity News Service, E. F. Hutton, and the U. S. Weather Service. It has also obtained contracts for two-way Ku-band systems worth $1.2M with the state of Queensland in Australia, and a 3000 site network for Farmer's Insurance Group. GTE Spacenet, carries the Federal Express netowrk and was the winner on a $40 million 2,200 site network for K-Mart. It also carries much of the traffic for Private Satellite Network which offers private

programming for the business and financial communities. The company's customers include AT&T Information Systems, Digital Equipment Corporation, J. C. Penny, Merrill Lynch, MicroAge Computer Stores, the U. S. Army, and Wang Laboratories.
Other carriers and service providers involved in the business are Hughes, MCI, Houston International Teleport, Tymstar, Vitalink, and Xerox.

Among the equipment vendors, MA/Comm has contracts with Federal Express for a network that could have reached 25,000 terminals, Wal-Mart Stores for an estimated $16 million and Southland Corporation for a $6 million network. Scientific-Atlanta claims to have 15 percent of the data network market and 80 percent share of the video market. Other equipment vendors include: Avantek, Comsat Technology Products, Fairchild/Alcatel, Harris, NEC, Telecom General, and Tridom.

5.0 ISSUES

Users studying the application of VSAT technology to their own networks frequently encounter several issues and trade-offs such as C band vs Ku band, multiple access methods, and costs and value added features of the system. These issues are discussed in the following paragraphs.
C Band vs Ku Band: is a function of Ku band availability and frequency coordination. In the U. S., Ku band systems are increasingly the choice due to the simplified frequency coordination and site selection for networks. The advantages and disadvantages are summarized in exhibit 7.
Multiple-Access Method: involves a choice between time-division-multiple-access (TDMA) and random access. TDMA and its derivatives, divide transmission time into slots. Each remote site is assigned an exclusive time slot in which it can transmit. Random Access methods allow a station to transmit any time that it has a message. Since two or more sites may choose to transmit data at the same time, the message may be destroyed. The sites must then reschedule their transmissions by waiting for a randomly selected period and trying again. This method was named "ALOHA" by its originators at the University of Hawaii. Aloha throughput can be improved by dividing time into slots and only allowing a station to transmit at the start of a slot, sometimes called slotted Aloha. The advantages and disadvantages of these techniques are summarized on exhibit 8.
Costs and value added features: should be considered when comparing VSAT networks with other networking methods. These issues include lease vs buy, error-free virtual circuits with full connectivity, location insensitivity, data rate, code set, and protocol independence, and owner network control, allowing ease and flexibility in adding or moving stations.

6.0 SUMMARY

VSAT technology implementation in the United States in 1985 and early 1986 included many large orders and forecasters were very optimistic about huge sales into the decade. More recently, large sales have been dormant and carriers and network suppliers have shifted from private network sales to shared hub network sales. There appears to be an over-supply of vendors and their future will contain pitfalls. Users are bombarded with vendor choices and alternatives to VSAT networks. Those users that have adopted the technology are not satisfied with the reduction of their leased line costs. They are more committed to making their businesses more efficient. Satellite networks have inherent advantages to improving the efficiency of businesses and VSAT technology appears to be on the threshold of demonstrating these advantages.

EXHIBIT 1

One-way Vsat Network

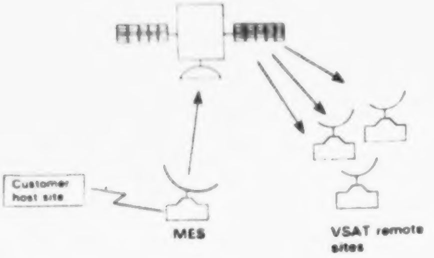
Customer host site
MES
VSAT remote sites

EXHIBIT 2

Two-way Vsat Network

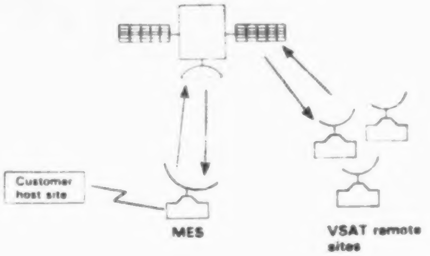
Customer host site
MES
VSAT remote sites

EXHIBIT 3

Point-to-Point Network

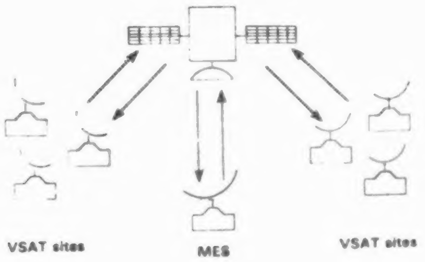
VSAT sites
MES
VSAT sites

EXHIBIT 4

VSAT Network, Hub at Customer's Site

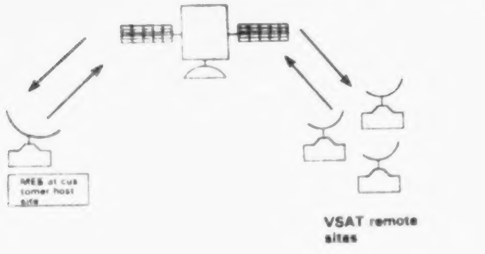
MES at customer host site
VSAT remote sites

EXHIBIT 5

VSAT Block Diagram

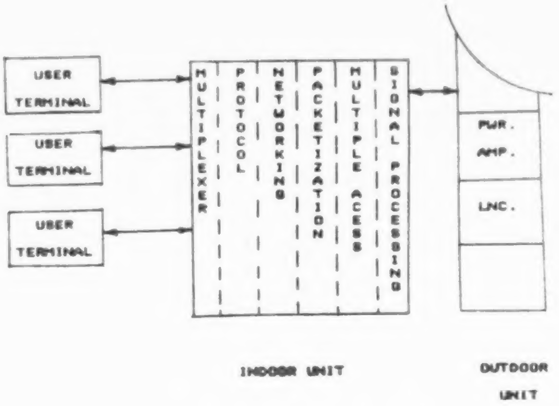
USER TERMINAL
USER TERMINAL
USER TERMINAL
MULTIPLEXER
PROTOCOL
NETWORKING
PACKETIZATION
MULTIPLE ACESS
SIGNAL PROCESSING
PWR. AMP.
LNC.
INDOOR UNIT
OUTDOOR UNIT

EXHIBIT 4

MASTER EARTH STATION (MES), BLOCK DIAGRAM

(HUB)

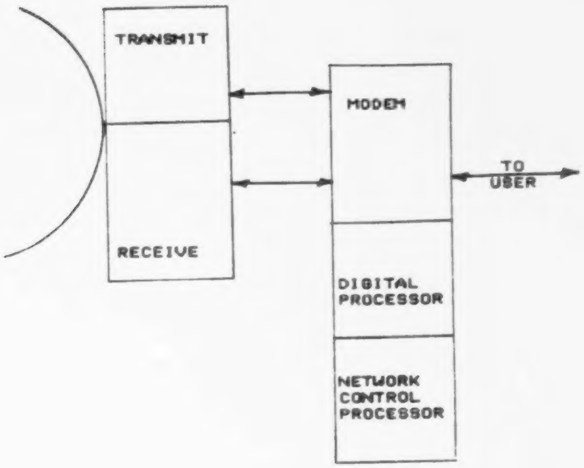

EXHIBIT 5

Multiple Acess Methods

TDMA	RANDOM ACCESS
ADVANTAGES	
o Architechtural Simplicity and stability	o Improved delay characteristics in low-traffic network
o High theoretical band utilization.	o remote-site costs less due to less stringent slot timing.
	o narrower bandwidth
DISADVANTAGES	
o Higher cost of Equipment	o lower utilization of channels due to margin for collisions.
o Higher delay - to wait for time slots.	o max. delay is difficult to guarantee

EXHIBIT 9

COSTS AND VALUE ADDED FEATURES

PRICES FOR TYPICAL C AND Ku BAND SYSTEM

Master Earth Station with redundancy	$500,000 to $1,000,000
Remote Earth Station	$7,000 to $15,000
Monthly Maintenance (each remote)	$30 to $70
Monthly space segment cost	$4,200 to $15,000

OTHER CONSIDERATIONS

Recurring Costs versus Capital Costs

Data rate, code set, and protocol independence

Owner network control

EXHIBIT 7

C BAND VS Ku BAND SUMMARY

C BAND	Ku BAND
ADVANTAGES	
o Inexpensive Hardware	o Satellite only frequency—simplifies licensing, site selection, and coordination
o Less susceptible to weather outages	o Higher power satellites, smaller antennas.
DISADVANTAGES	
o Shared Band with terrestrial services.	o Electronics, currently more costly than C Band.
o Larger antenna needed	o Increased chance of weather outage.

EQUATORIAL SPREAD SPECTRUM TECHNOLOGY

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Hong Kong

1. ABSTRACT

Equatorial's Spread Spectrum Technology has played an important role in developing inexpensive high performance data networks in the United States. The same Technology is also ideally suited to providing traditional communications services in Developing Countries. Basic telex networks can be rapidly established or extended at low cost. Thin line digital telephone services can also be provided. The same network can simultaneously carry many different services.

2. INTRODUCTION

Equatorial's one way broadcast system, or INTELNET I type service has 34,000 antennas connected in the U.S.A. and South America. This service provides news, financial data and weather service information. From these beginnings the two-way interactive service has been developed, or the INTELNET II type service. Equatorial now has 2,500 antennas serving 31 customers. The largest network for an Insurance Company has 2,000 antennas connected. The two way service in the U.S.A. has been used to provide high quality data by-pass networks, connecting remote personal computers Host Computers, it can be used to provide most basic communication needs in other operational scenarios.

The most powerful attribute of a two-way interactive satellite network is its ability to connect together remote locations where there are limited, or no conventional means of communication. A micro earth station can be installed and put into service within a few hours. National and International connection can be provided into existing networks by placing a Micro Earth Station at any location within the satellite transponder footprint.

Conventional Intelsat C-Band transponders available in the region can support networks containing 8,000 - 10,000 Micro Earth Stations or VSATS. Higher power Regional or Domestic satellite transponders can carry significantly more Micro Earth Stations. The latest addition to our family can also provide these services in Ku-Band.

3. APPLICATIONS

Telex is still one of the most valued forms of business communication with its almost total world access and its well documented directory of subscribers. The Equatorial system with it's built in Packet Switch is eminently suitable to carry this type of service.

Whilst, not pretending to replace conventional telephone distribution networks, the Equatorial system is capable of providing thin-line digital voice communications. The advances in digital voice linear predictive encoding techniques have produced very acceptable 4.8 kbps voice quality modems.

A new and very interesting application recently demonstrated at the International PEACESAT Consortium is the Educational two-way system comprising of voice communication, video and on-line video graphics using a PC and graphics tablet.

The Equatorial Network is ideally suited for large, widely distributed "thin route" networks. In the United States the Equatorial system is being used for many different applications which can also have application in other Countries. Where there is a requirement for a network to provide inquiry/response, data acquisition, command acknowledgment and inquiry/database update then a Star Network Satellite System is most suitable.

Examples of these applications are as follows:-

Banking:
- Administration, teller and ATM transactions.
- Consumer finance and securities brokerage applications.

Process control, monitoring and security systems:
- Electric Utilities
- Oil and gas pipe lines
- Seismic monitoring networks
- Weather station data acquisition and distribution
- Other SCADA application

Branch office automation and remote inquiry update:
- Insurance
- Other service or manufacturing companies

Dealer inquiry update systems.

Centralised pharmacy support systems.

Agent inquiry-update system for airlines and travel agencies.

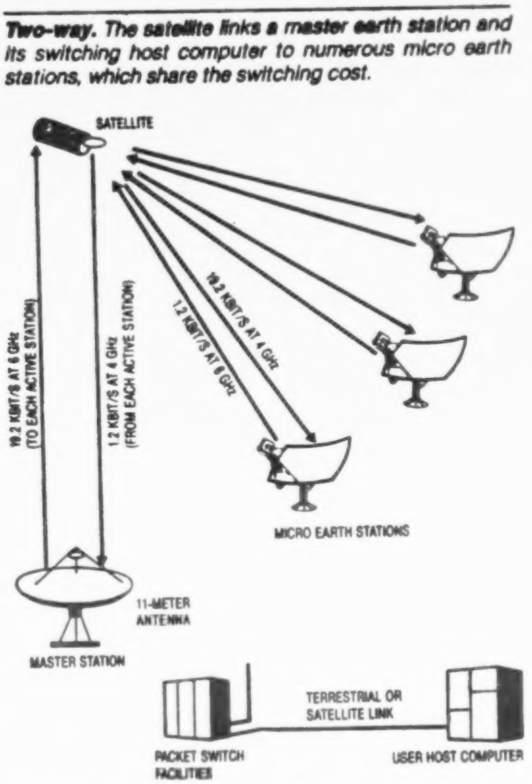
Retail and Wholesale point-of-sale:
- Credit verification
- Credit or debit card sale

Retail and department stores:
- Inventory/stock inquiry-update
- Point-of-sale
- Ordering
- Accounting

4. STAR NETWORK

The Equatorial system is a star based network. The Master Earth Station at the central node is typically an 11 metre or an Intelsat Standard B type antenna. The Equatorial master controller with it's Packet Switch is located at the Master Earth Station. Using Spread Spectrum and Code Division Multiple Access (CDMA) techniques it is possible to use small Micro Earth Stations or VSAT with Elliptical Antennas 72 inches by 43 inches to work back into the Master Earth Station from remote locations. Each outgoing carrier from the Master Earth Station can support typically 4,000 - 5,000 Micro Earth Stations. The number of outgoing carriers in a network is limited only by the number and capability of the satellite transponders. In a VSAT network the Satellite transponder is always working in a power limited mode, the power being used by the outgoing carriers. The incoming carriers from the Micro Earth Stations use an insignificant amount of power from the satellite.

Two-way. *The satellite links a master earth station and its switching host computer to numerous micro earth stations, which share the switching cost.*



5. DATA RATES AND PERFORMANCE

The Master Earth Station outgoing carriers operate at 153.6 Kbps, whilst the incoming carriers from each Micro Earth Station operate at 1.2 Kbps or 9.6 Kbps. Using CDMA Techniques it is possible for up to 120 Micro Earth Stations to have instantaneous access within each inbound carrier. Since the transponder is operated in a power limited , rather than a bandwidth limited mode, plenty of bandwidth is available, thus each outbound carrier can support up to 4 inbound carriers. The actual number of inbound carriers is dependent on the pattern of traffic and the traffic load. In this configuration 10 percent of the Micro Earth Stations can have simultaneous access. The Micro Earth Stations operate in a burst mode and only transmit data packets when traffic is present, or when they are requested to respond to the Master Earth Station. Within any short time frame all the Micro Earth Stations in the network can be in communication since in practice they do not all transmit instantaneously. Loss of data during periods of instantaneous overload is prevented by the use of X25 Packet Protocols. Increases in traffic loading up to 50 percent is handled by forward error correcting techniques, ultimately packet re-transmission will be requested. The degradation of the system with increased simultaneous access is very gradual.

The Equatorial system operates at Bit Error Rate (BER) of 1 in 10 to -7 using half rate forward error correcting (FEC) techniques over the radio path. The packet retransmission facilities ensure an end to end data integrity BER of 1 in 10 to -9.

6. NETWORK OPERATIONAL CONFIGURATION

A Star Network comprising thousands of Micro Earth Stations can be effectively partitioned into many separate systems carrying different types of services. 1.2kbps and 9.6kbps Micro Earth Stations can operate in the same network. Each Micro Earth Station has two separate digital interface ports and can carry two entirely separate services. Thus a 9.6kbps Micro might carry 4.8kbps digital voice and also 4.8kbps multiplexed data. Each output port can be configured to operate at any speed with a wide selection of interface protocols.

The Equatorial system has its own Integral Packet Switch which provides all the switching within the network and thus each separate system can operate as a stand alone switched system. The Master Controller can interface into the outside world through Host Computer Interfaces (HCI). Each system may have multiple HCI's, thus a telex system could be interfaced into the Telex Networks of several Common Carriers either Nationally or Internationally. Conversely, a Micro Earth Station could provide the necessary interface into an external network, being located at the Telex Switching Centre.

A typical scenario might be a group of Islands operating a star network from their Administrative Capital and locating a Micro Earth Station at the Telex Switching Centre of a friendly large Nation. Thus they have gained their own very cost effective communications network with the benefits of full International Connectivity.

Another scenario might be that of a friendly neighbor providing the Network Master Controller at his existing Earth Station facilities with it's International Access. He could provide partitioned systems within the network to his smaller neighbors, thus sharing the costs of space segment and the Master Earth Station.

7. OPERATIONAL BENEFITS

As in the United States, there great advantages in using satellite systems to bypass the existing terrestrial facilities. The Bit Error Rate (BER) performance and availability of the Equatorial system is vastly superior. The cost of such as system is very much cheaper in terms the tariffs that can be offered by terrestrial means. Terrestrial tariffs are based on distance, whilst with a satellite system, the tariffs are irrespective of distance. Removal of data from terrestrial systems often provide the badly needed expansion capacity for telephony.

8. CODE-DIVISION MULTIPLEXING

Until recently, most satellite networks involving tens or hundreds of earth stations, operating at a low average data rate (less than 120 bit/s) and low duty-cycle (less than 10 percent), have used a number of time-division multiple access (TDMA) or frequency-division multiple access (FDMA) schemes. In order to efficiently utilize the channel capacity in TDMA schemes, earth station circuitry is required for complex timers and dynamic reallocation of time slots. Similarly, efficient FDMA schemes require additional earth station circuitry for rapid frequency changing (agility) and control. The main disadvantage of most channel-capacity-efficient approaches is that they require a reservation mechanism to manage and monitor placement (in time and/or frequency) and transmission of messages. This mechanism adds both overhead and complexity as well as increases the network's response time. Even without this mechanism, not all channel capacity is used as the duty cycle of an earth station drops below 100 percent is its allocated channel capacity. As the network becomes very large with hundreds of earth stations, most with low duty cycles, an access method known as code-division multiple access (CDMA) becomes the most efficient for many applications.

- FDMA. The frequency-division multiple access technique assigns each user a specific uplink and downlink carrier frequency within the bandwidth of the transponder. Its major shortcomings: the potential for interference from adjacent channels; the intermodulation distortion of multiple signals passing through the satellite simultaneously; and the requirement for agile-frequency synthesizers. FDMA requires a reservation mechanism so that requests for channel capacity can be made through dynamic assignment of transmit frequency. The satellite channel remains unused during the tens of milliseconds required to switch frequencies. This means that delay is incurred for the establishment of each new frequency. As a result, this multiple-access scheme is optimized for high duty-cycle (80-to-100 percent) traffic, with few channel-assignment changes to improve capacity being required.

- TDMA. Time-division multiple access requires each user assigned to a channel to employ a specific time slot in which to transmit. Each user is either allowed the entire capacity of the channel in the assigned time slot or contends for the slot with other users. In the latter case, when collisions occur, they are assumed to irreparably damage all messages in that slot, requiring retransmission of them all. To operate most efficiently, TDMA requires accurate timing for each station in the network to compensate for different distances from the satellite. In addition, a dynamic reservation mechanism is needed to allocate a particular time slot to each earth station on an as-required basis. Most networks avoid the overhead and delay of a reservation scheme and simply assign slots to stations as they are added to a channel.

Alternatively, for low duty-cycle earth stations, slots are randomly accessed by all users (such as with the slotted-Aloha method) as required. Here, channel capacity is theoretically limited to 36 percent (where the delay approaches infinity). Practical channel capacity in the latter case is in the 10-to-20 percent range, depending on the average delay tolerable for the application. At a 10 percent load level, about 10 percent of the transmissions collide. The retransmission percentage increases exponentially as channel loading increases.

Another factor in TDMA is that an assigned time slot implies that the slot size represents a certain message length. Any longer message will be delayed until enough assigned slots have occurred to carry the full message. Any shorter message leaves unused channel capacity in the slot. FDMA and CDMA do not have a similar slot-sizing problem.

- CDMA. Code-division multiple access takes advantage of spread-spectrum technology, which allows transmission of signals without interference. The information spectrum is spread into a wider bandwidth (up to 2,000 times the bandwidth of data alone) by a pseudorandom noise sequence of "microbits." In this technique, each data bit is encoded with binary sequence of up to several thousand (one or zero) microbits. Any receiver can recover the original information by using the same sequence to decode the encoded data bits. Any other well-selected pseudorandom sequence (selected mathematically to cause minimal interference in a shared channel) merely increases the noise slightly in the receiver and, therefore, degrades the performance of the receiver by a negligible amount. The number of stations simultaneously transmitting in a channel is limited by the aggregate of code-noise increments that increase the receiver noise to the point that reduces the signal-to-noise ratio of the receiver to its threshold of usable operation [usually a rate of one bit in 10(7)].

With CDMA, satellite power is allocated only during the micro earth station's actual transmission. In a typical network, about 120 stations may be active at one time in a shared channel. (The C-band channel is 3.0 MHz wide, and each station operates at 1.2 kbit/s, 1 watt.) The bit error rate increases about one order of magnitude for each 25 percent increase in the number of active stations above the 120 nominal, with no message loss during overload conditions of up to about 50 percent.

The CDMA process is cost-efficient for low-duty cycle, low-average data rate earth stations. This cost-efficiency prevails because the signals occupy the same frequency channel (hence require no frequency agility), are time independent (hence require no network-wide packet level timing or synchronization), do not suffer from collision-caused retransmission delays, and are initiated without having to make a slot reservation (hence avoiding the double-hop reservation-transmission delay of 0.5 seconds).

Roger G. Clark, Equatorial Pacific's Technical Director, has a B.Sc. with Honors from London in Electrical Engineering. Previously Clark worked for Cable & Wireless as Engineering Manager, Radio & Satellite. He has 23 years of experience in Telecommunications.

The Network Monitor and Control of the Mini-Earth Station Networks

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NEC Corporation, Tokyo, Japan

1. Abstract

In the satellite data communications networks using the mini-earth stations, a centralized network monitoring and control function is indispensable to achieve efficient and reliable network operation, as well as to perform quick and easy network reconfiguration reflecting the change of the traffic requirements. Such function is performed by a system called Satellite Network Control Center, which is composed of a high performance mini-computer system.

2. INTRODUCTION

The economical and operational advantages of satellite based data communications networks using the mini-earth stations compared with conventional terrestrial networks have been widely accepted recently. (1) (2)

This technique is most suitable to connecting many user terminals deployed over a wide geographically dispersed area, with their host computers or with each other. The primary applications include point of sales (POS), banking/financial and credit card verification, and other transaction oriented computer data, as well as high resolution facsimile image data.

The mini-earth stations, easily installed at the user premises, will support user data terminals directly connected to them. The mini-earth station network will replace the conventional terrestrial data network with significant cost savings.

The mini-earth station network can be effectively applied for both transaction and batch-type data transmission with advanced satellite access schemes such as NEC's proprietary Adaptive Assignment Time Division Multiple Access (AA/TDMA) method. (3)

One of the advantage of the mini-earth station network is that it can be fully controlled by its user. He can monitor the operation of his network from his monitor console. Any malfunction which might occur would be informed to the operator at once. He can take necessary action to restore the network operation promptly. When he want to install a new mini-earth station, or want to reconfigure his network to match his ever changing requirement, it can be controlled from his console.

These monitor and control function is very important for the user of the mini-earth station network. It is provided by the Satellite Network Control Center (SNCC), composed of a high performance mini-computer system with elaborate software.

In this paper, NEC's mini-earth station system called NEXTAR is presented. In particular, the function of the SNCC is discussed in detail.

3. MINI-EARTH STATION NETWORK

The typical NEXTAR mini-earth station satellite data network consists of user data terminals, mini-earth stations, a satellite, a hub earth station and a host computer system as shown in Fig.1. The user terminal are connected to the host computer through satellite channels.

A star type network configuration may be the most suitable for a mini-earth station network. Each mini-earth station can communicate only with the hub earth station, which is equipped with a relatively larger antenna. Since direct communications between mini-earth stations need more power for both the mini-earth stations and the satellite, it may not be economical except for special cases.

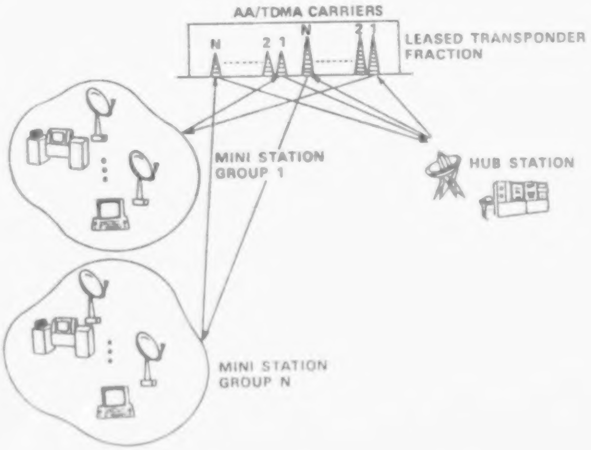

Figure 1. Mini-Earth Station Network

Ku-band satellites are particularly suitable for these applications since interference problems are less likely than in C-band satellites. Also, antennas with very small aperture, such as 1.2 meter or 1.8 meter diameter can be used for the mini-earth stations using the Ku-band.

The mini-earth stations consists of an antenna, an outdoor unit (ODU) and an indoor unit (IDU). A block diagram of the mini-earth station is shown in Fig.2. A picture of the mini-earth stations with a 1.2 meter antenna and a 1.8 meter antenna is shown in Fig.3. These mini-earth stations are installed very easily on roof tops, on a wall, or in the back yard of the users office building, where the user data terminals are located. The IDU and the user terminals are usually connected directly using standard interfaces at DCE/DTE points. The baseband processor (BBP), which is an integral part of the IDU, performs data processing and satellite access control.

The hub earth station is typically located near the host computer system. A medium size antenna ranging from 3 meter to 11 meter is used depending upon link budget requirements. Figure 4 shows a typical hub earth station. The block diagram of the hub earth station is shown in Fig.5. Typically, several lines from the front end processor (FEP) of the host computer system are connected to the satellite channel modulators and demodulators through data processing and controller units called Satellite Access Controller (SAC).

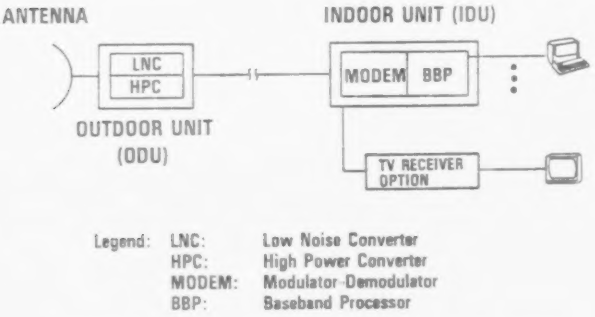
ANTENNA
INDOOR UNIT (IDU)
LNC
HPC
MODEM
BBP
OUTDOOR UNIT (ODU)
TV RECEIVER OPTION
Legend:
LNC: Low Noise Converter
HPC: High Power Converter
MODEM: Modulator-Demodulator
BBP: Baseband Processor

Figure 2. Configuration of Mini-Earth Station

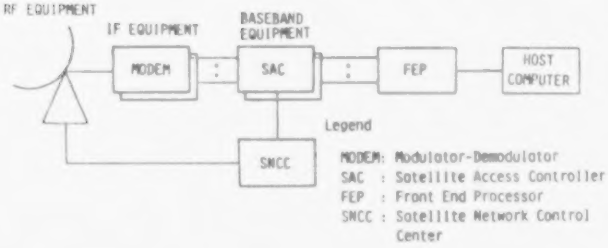
RF EQUIPMENT
IF EQUIPMENT
BASEBAND EQUIPMENT
MODEM
SAC
FEP
HOST COMPUTER
SNCC
Legend
MODEM: Modulator-Demodulator
SAC : Satellite Access Controller
FEP : Front End Processor
SNCC : Satellite Network Control Center

Figure 5. Configuration of Hub Earth Station

The Satellite Network Control Center (SNCC) is typically collocated with the hub earth station. It provides automated monitor and control of the network, of which details are described in the following section. The SNCC may be further connected to a Network Control Center (NCC) which monitors and controls the users whole network integrating satellite ones and terrestrial ones, if such NCC is provided.

4. SATELLITE NETWORK CONTROL CENTER

4.1 GENERAL

The SNCC provides automated network configuration, centralized status and alarm monitoring, traffic throughput statistics, alarm processing and logging, and system diagnostics for on-going network management and maintenance functions.

The SNCC enhances network management with a monitor/control console with display, to monitor the status of every mini-earth stations, satellite channel, and the hub earth station. Certain control functions can be effected automatically or manually from this device. This control system allows quick problem identification and resolution, by isolating problems to a particular mini-earth station, DTE, or the hub earth station.

The SNCC functions are summarized as follows:

- Activate and de-activate satellite network.
- Activate and de-activate remote mini-earth stations individually, or by group/subnetwork, or all.
- Configuration and re-configuration management of the network.
- Periodic health check of remote mini-earth stations.
- Centralized alarms and system diagnostics.
- Statistics information gathering and reporting traffic, number of user packets, average of user packet length, satellite channel failure rate.
- Logging of alarm and statistics.
- Automatic switchover of redundant Satellite MODEM/SAC
- Software down-line loading (DLL) to the SACs and BBPs

4.2 SHARED HUB AND SHARED SNCC

In order to increase cost performance of SNCC and hub equipments, shared SNCC and shared hub concept may be applicable. Shared hub concept is that plural customers share a hub equipments by SAC basis or SAC's terrestrial port basis.

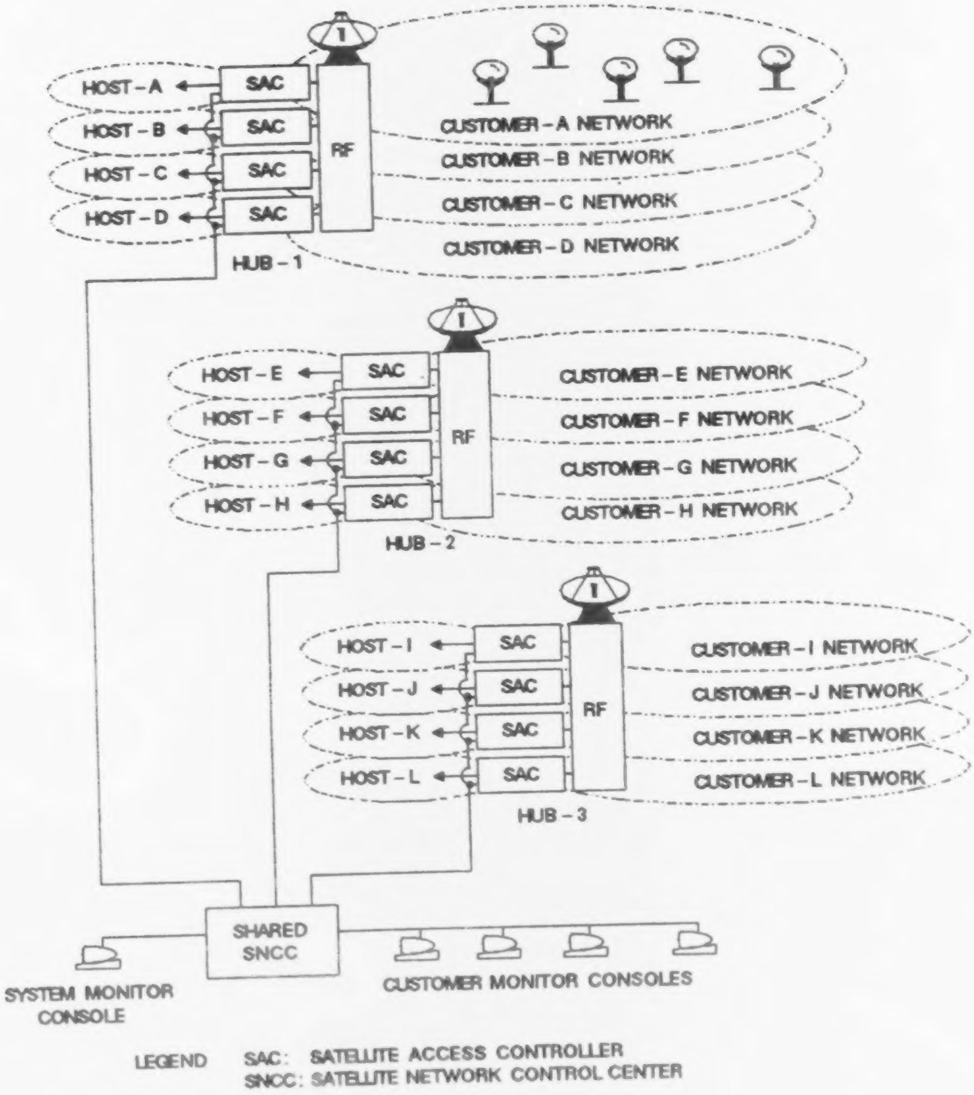
HOST - A
HOST - B
HOST - C
HOST - D
SAC
SAC
SAC
SAC
RF
HUB - 1
CUSTOMER - A NETWORK
CUSTOMER - B NETWORK
CUSTOMER - C NETWORK
CUSTOMER - D NETWORK
HOST - E
HOST - F
HOST - G
HOST - H
SAC
SAC
SAC
SAC
RF
HUB - 2
CUSTOMER - E NETWORK
CUSTOMER - F NETWORK
CUSTOMER - G NETWORK
CUSTOMER - H NETWORK
HOST - I
HOST - J
HOST - K
HOST - L
SAC
SAC
SAC
SAC
RF
HUB - 3
CUSTOMER - I NETWORK
CUSTOMER - J NETWORK
CUSTOMER - K NETWORK
CUSTOMER - L NETWORK
SHARED SNCC
SYSTEM MONITOR CONSOLE
CUSTOMER MONITOR CONSOLES
LEGEND SAC: SATELLITE ACCESS CONTROLLER
SNCC: SATELLITE NETWORK CONTROL CENTER

Figure 6. Shared Hub and Shared SNCC Concept

Furthermore, shared SNCC and shared hub concept should be combined in order to obtain the best cost performance and to realize a centralized controlled VSAT networks for plural customers as shown in Fig.6. Shared SNCC must provide, two layers of monitor and control functionalities, one is a total network monitor and control functionalities for the VSAT networks provider, the other one is a limited network monitor and control functionalities for each customer. The limited network monitor and control functionalities mean that one customer can monitor and control only their own sub-network, and the customer can not monitor status of other customer's network, and of course, the control functionalities are allowed to the extent which does not affect to other customer's network.

4.3 SNCC HARDWARE

NEC's high performance mini-computer system called MS Series is used for the SNCC. The major specifications of the typical system (MS-140) are shown in Table 1. A picture of the system and its block diagram are shown in Fig.7 and 8.

The SNCC is interfaced with the SACs to gather the network information and to control the network operation, while it is interfaced with the hub RF equipment through a monitor and control unit (M&C).

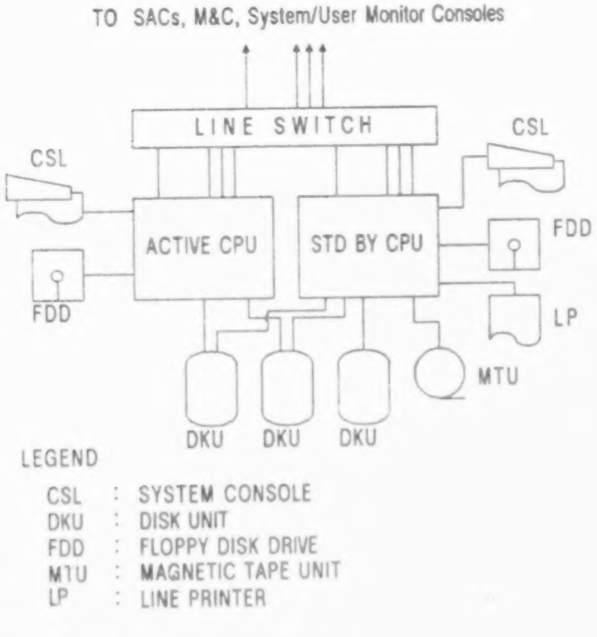

Figure 8. Configuration of SNCC

The SNCC can be configured as simplex system or duplex system according to the user requirements. When it is configured as duplex, the standby CPU will replace the operating one automatically when the operating one fails. Since the mini-earth station network itself will continue to operate normally even when the SNCC fails, the simplex system may be appropriate from the economical point of view when rarely happened short time loss of network monitoring and control function is tolerated.

4.4 SNCC FUNCTIONS

START UP/SHUT DOWN OF NETWORK/INDIVIDUAL MINI-EARTH STATION

At the time of the network start up, the SNCC sends out a start up command to the SACs of the hub earth station and BBPs of the mini-earth stations. Then the network will begin to operate. Similarly, the network operation can be shut down by the SNCC command.

Also individual mini-earth stations can be started up or shut down by the SNCC command.

Table 1. Major Specification of MS140 Mini-Computer

CPU

- Architecture : 32 bits
- Cycle Time : Write 435 nsec/4 bytes, Read 495 nsec/4 bytes
- Resister : 33 registers
- Instruction : 171 instructions and 62 optional instructions
- Interruption Level: 64 Levels

MEMORY

- Capacity : 4 Mbytes

DATA TRANSMISSION

- Architecture : DMA
- Speed : 6.3 Mbytes/sec
- Number of Channel : 1024 channels (512 pairs Input/Output)

PERIPHERALS

- Disk Unit : 125 Mbyte/Unit(format) x 3
- Magnetic Tape : 1600/6250 bpi x 1
- Line Printer : 900 lpm x 1
- System Console : 55 cps Keyboard/Printer

COMMUNICATION CONTROL UNIT

- Speed : Up to 9.6 kbps
- Protocol : SDLC, HDLC, Basic, A-Sync.

NETWORK CONFIGURATION AND RE-CONFIGURATION MANAGEMENT

Network configuration parameters such as the number of mini-earth stations connected in the network, the address of the individual mini-earth station in the network, its inbound and outbound RF frequencies, the information of the DTEs connected to the mini-earth station including their network address, protocol and line speed, etc. are stored and managed by the SNCC.

Similarly, network system generation parameters such as system parameters of AA/TDMA satellite access method, number of outstanding frames, data link timer values and retry count out values, etc. are also stored and managed by the SNCC.

These network parameters are downline loaded from the SNCC to the SACs of the hub earth station and BBPs of the mini-earth stations at the start up of the network.

When required, they can be changed by the SNCC operator commands. Then the new parameters are downline loaded to the concerning SACs and/or BBPs. Most of the changes can be made effective without disruption of the network operation, except for changes of some parameters which inevitably effect the network operation.

For instance, addition of a new mini-earth station into the network, or deletion of a mini-earth station from the network can be done without affecting the operation of the other portion of the network.

HEALTH CHECK OF THE MINI-EARTH STATIONS

The SNCC periodically polls every BBPs. If it returns an answer saying it is working well, no action will be taken. However if it returns no answer or a no-good answer, the mini-earth station is assumed to be failed after some number of retrying. Then alarm message is displayed on the monitor console of the SNCC, and corrective actions can be taken by the operator.

STATISTICAL INFORMATION GATHERING

The network operation statistics such as number of packets carried, etc. are gathered at the SAC, and then they are further moved to the SNCC periodically. The information is edited by the SNCC and the reports are generated.

SOFTWARE DOWNLINE LOADING

The most software of the SAC and the BBP are stored in random access memory (RAM), except for those of satellite access control and initial loader which is stored in the non-volatile read only memory (ROM). Therefore, at the initial start up, the software for SAC and BBP is downline loaded from the SNCC.

When the primary power for a mini-earth station is accidentally interrupted, the software stored in the RAM will be lost. Then, the ROM resident software of the BBP will automatically send a request for the software downline loading after the restoration of the primary power. Thus the software will be automatically downline loaded and the operation will be restored.

Thanks to the software downline loading capability, the software version up and/or change of the protocol handling software can be done very easily with a central control of the SNCC.

5. CONCLUSION

The mini-earth station satellite data network can offer end-to-end economical integrated digital data communication capabilities. Its advanced features allow for a very flexible network operation, ease of expansion and relocation to cope with ever changing user requirement for the network, as well as continuous network performance monitoring. Such functions can be realized by the sophisticated SNCC hardware and software.

ACKNOWLEDGEMENT

The authors wish to thank members of NEC Corporation and NEC America, Inc, who participated in the development of the mini-earth station systems.

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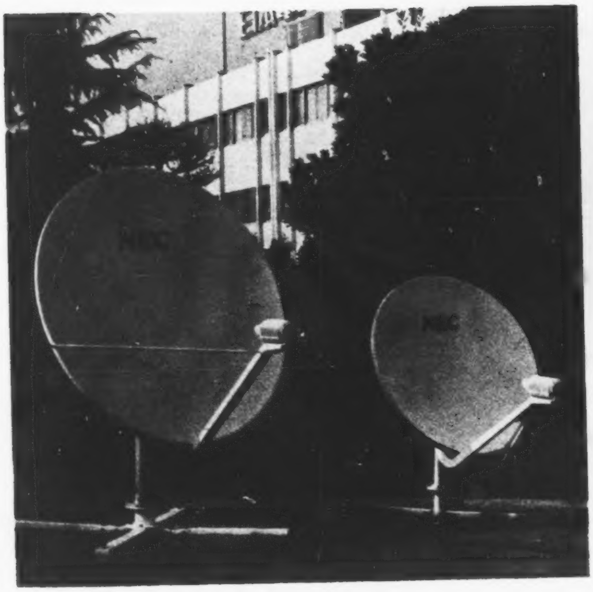

Figure 3. 1.8 meter and 1.2 meter Mini-Earth Stations

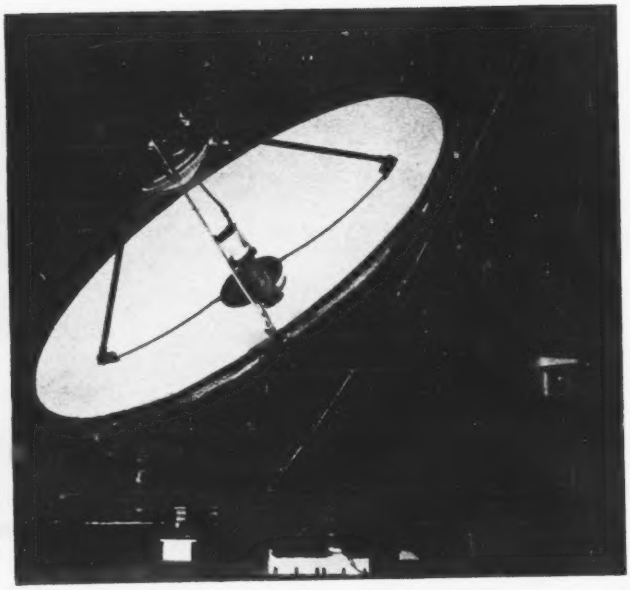

Figure 4. Typical Hub Earth Station

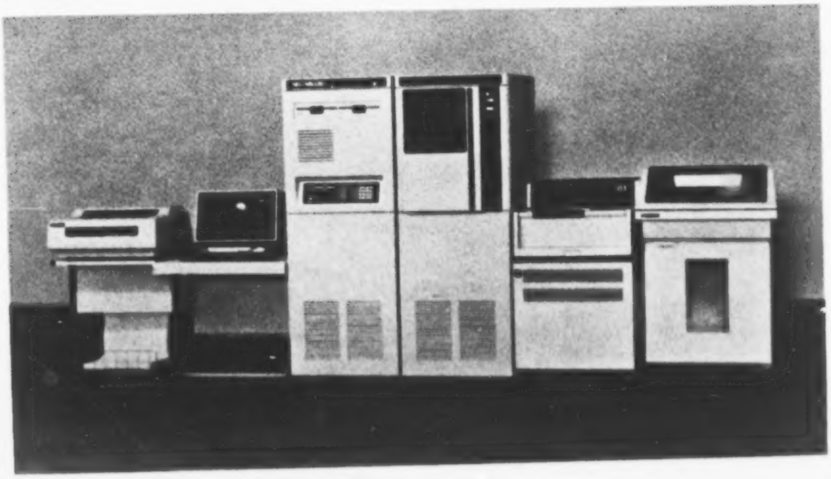

Figure 7. Mini-Computer for SNCC

APPLICATION OF MILLIMETER-WAVE SATELLITE COMMUNICATION TO ASIA-OCEANIAN REGION AND CONSIDERATION OF EXPERIMENTAL SYSTEM

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ABSTRACT

This paper considers the expedient millimeter-wave satellite communication system for the Asia-Oceanian region. The purpose of this paper is to show; (i) the technical possibility of establishing a simple satellite communication system, (ii) the applicability of millimeter-wave to the Asia-Oceanian region, and (iii) the method of experimentation. The paper summarizes the study of the satellite-fed millimeter-wave personal communication system using inexpensive and simple small earth stations. And considers a millimeter-wave satellite communication system as one of the future systems for the Asia-Oceanian region. First, we calculated the rain margin or the link availability according to the rainfall climatical classification in the Asia-Oceanian region, and determined the possibility of using millimeter-wave in the Asia-Oceanian region. The principal purpose of this system is for information exchange between organizations such as universities or for personal communications. Taking account of that, we investigated transmission rate, channel capacity and parameters of the on-board equipment and earth stations. An example system configuration is shown. Finally, an experimental system, using Japan's Engineering Test Satellite-VI (ETS-VI), which will be launched in 1992, is described.

1. INTRODUCTION

It is forecast that future needs for satellite communication services will grow and their requirements will be diversified [1]. In order to meet this growth and the diversified requirements, we must develop new frequency bands for satellite links.

We have conducted a study into a satellite-fed personal communication system, using millimeter-wave, as a possible future satellite service. The study's aim was to develop a communication system using inexpensive and simple small earth stations. The millimeter wave band is attractive, because they are largely unused, and the communication system can use small earth stations with high gain antenna. However, these frequencies suffer from attenuation during precipitation. The effect of rain attenuation is particularly serious. In order to achieve a link availability of more than 99%, which is necessary for a trunk communication link, we must use expensive measuring systems to overcome rain attenuation, such as site-diversity switching. Therefore, we have proposed a system which allows some degradation in transmission quality, during periods of heavy rain.

Originally, a simple communication networks using NASA's ATS-1 was configured in the Pacific Ocean area [2], demonstrating the needs in the Asia-Oceanian region for a simple communication system for the exchange of information between organizations such as universities. In this connection, we now consider a millimeter-wave satellite communication service system in the Asian and Oceanian region. The purpose of this paper is to show; (i) the technical possibility of establishing a simple satellite communication system, (ii) the applicability of millimeter-wave to the Asia-Oceanian region, and (iii) the method of experimentation.

2. PERSONAL COMMUNICATION SYSTEM USING SATELLITE

In this chapter, we summarize the concept of a satellite-fed millimeter-wave personal communication system which has been studied for three years [3]. In the satellite-fed personal communication system, each person or each family can have a communication service by receiving signals from a satellite at his own earth station. Figure 1 shows the outline of the personal communication system using the millimeter-wave in the 50/40 GHz band. A user's terminal has a 30 cm-diameter antenna and a typi-

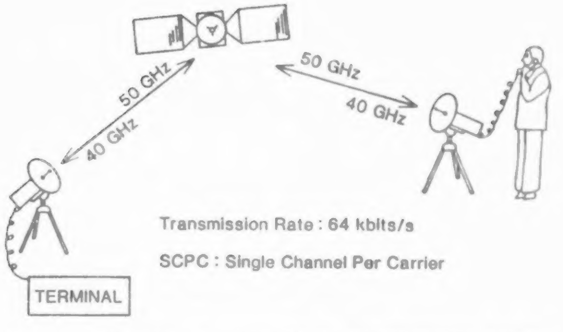
50 GHz
40 GHz
50 GHz
40 GHz
Transmission Rate : 64 kbits/s
SCPC : Single Channel Per Carrier
TERMINAL

Fig. 1. Concept of personal communication system.

cal transmission rate of 64 kbits/s.

The terrestrial personal radio system in Japan is presently permitted to operate in the 900 MHz band. Coverage is, however, limited to about 20 km. If coverage of such a personal radio system could be extended by using a satellite, the potential users of such personal radios would be increased. The frequency bands, used for the satellite communications, have many band width and utilization limitations according to the Radio Regulations. Therefore, the millimeter wave of the 50/40 GHz band is very attractive for personal use because of its flexible utilization of the frequency band as well as its large bandwidth and its potential use of small earth stations with high gain antenna. The problem of rain attenuation can be overcome, in a personal communication link, because we do not require the same high link of 99%. We can accept a degradation in transmission quality and can even postpone communications during periods of heavy rain. Therefore, the 50/40 GHz band can be considered for a personal radio satellite system.

The transmission rate must be selected to cope with as many applications as possible, accordingly a transmission rate of 64 kbits/s was adopted. This rate can be used for TV conferences or transmission of voice, data, facsimile and still pictures. A forward error correction (FEC) technique will allow this system to be used for applications where improved reliability is required.

A key factor in realizing a personal radio system is to develop small and inexpensive earth stations. The size of the earth station antenna also depends on the development of a reasonably priced low noise receiver and high power transmitter as well as the development of a high performance satellite. According to the link budget, which will be described later, a personal radio system with a 30 cm-diameter antenna will be sufficient for point-to-point voice-communications.

An example of the beam coverage of a personal communication system for Japan is given in Fig. 2. The beam configuration has been determined by considering various conditions, for example, locality of rain fall, channel capacity corresponding to traffic, and satellite position in the geostationary orbit [4]. Using an 0.8 m-diameter on-board antenna, the main Japanese islands can be covered by 6 beams.

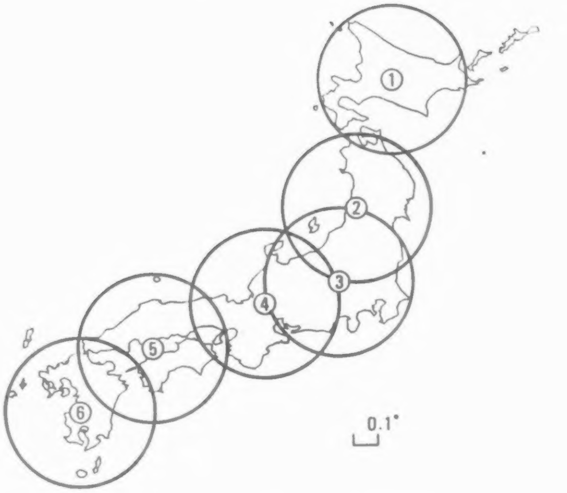

Fig. 2. An example of beam arrangements in Japan.

The satellite has 7 transponders, and each transponder uses a 40 GHz TWT amplifier with 20 W output power. One transponder is assigned to each beam, except beam 3, where two transponders are assigned, because larger transmission capacity is needed to meet the demand from the heavily populated area of Tokyo. In this case, the weight of the transponders is 180 kg and the consumption power is 1400 W [5].

3. SATELLITE COMMUNICATION SYSTEM FOR THE ASIA-OCEANIAN REGION

In this chapter, we described the proposed millimeter-wave satellite communication service system for the Asia-Oceanian region. Information exchange between libraries or universities in principal cities and a simple communication service among islands in the Pacific Ocean can be considered the main services. The simple millimeter-wave communication system will not provide high link availability, so users may have to wait to communicate during periods of heavy rain. However, inexpensive earth stations with small diameter antennas can be used, if the personal earth stations mentioned in Chapter 2 are applied.

3.1 Possibility of Establishing the Millimeter-wave Satellite Communication System

We calculated the rain margin or link availability in the Asia-Oceanian region [5]. Figure 3 shows the rainfall climatical classification in the Asia-Oceanian region and the geographical points for which we calculated the rain margin. Table 1

Table 1 Rain Margin Estimation in Asia-Oceanian Region

No.	Cities	Elevation Angle	Climatical Class.	Margin at 99% Link Availability 40 GHz	Margin at 99% Link Availability 50 GHz
		degree		dB	dB
1	Tokyo	47.2	M	6.2	8.7
2	Seoul	40.7	K	3.7	5.5
3	Peking	32.3	K	4.5	6.6
4	Taipei	46.8	N	8.9	12.4
5	Hong Kong	42.1	N	10.4	14.4
6	Manila	52.5	N	9.5	13.2
7	Hanoi	34.9	N	12.5	17.3
8	Phnom Penh	36.8	N	13.0	18.0
9	Bangkok	31.7	P	33.8	44.1
10	Rangoon	26.6	P	39.1	50.9
11	Kuala Lumpur	34.5	P	33.1	43.1
12	Singapore	36.9	P	32.1	41.8
13	Djakarta	37.8	P	30.0	39.1
14	Canberra	49.0	K	2.9	4.3
15	Wellington	36.0	K	3.7	5.4
16	Honolulu	27.1	D	9.8	14.1
17	Guam	73.0	N	7.9	10.9
18	Angaur	69.7	P	19.9	25.9
19	Port Moresby	78.3	P	18.5	24.1
20	Honiara	74.0	P	18.9	24.5
21	Port Vila	60.5	P	19.6	25.4
22	Noumea	58.0	N	8.5	11.8
23	Nauru	70.1	N	8.6	12.0
24	Funafuti	54.7	N	9.7	13.4
25	Suva	51.3	N	9.4	13.0
26	Nuku'alofa	43.7	N	10.3	14.2
27	Apia	43.4	N	11.0	15.3
28	Christmas	29.9	N	16.4	22.7
29	Papeete	19.9	D	13.1	18.8

shows the rain margins needed to establish 99% link availability for the various points in the region. These margins are estimated using Morita's method [6], and assume a satellite longitude of 150 deg. east. From Table 1, it is apparent that larger margins are needed at points in P climatical zones and in areas where the elevation angle of the satellite is low. However, even in Angaur where the largest margin is needed in the Oceanian regions, we can consider that a rain margin of 2.8 dB at 40 GHz and 4 dB at 50 GHz would be sufficient if the link availability is decreased from 99% to 95% as shown in Fig. 4. Consequently, we can see that use of millimeter-wave in the Asia-Oceanian region is a practical proposition.

3.2 System Design

Now, we can consider the design of a simple millimeter-wave satellite communication system for the Asia-Oceanian region. First, based on the study result of the millimeter-wave satellite-fed personal communication system, we assume that small and inexpensive earth station and the light-weight and small-sized satellite-borne transponder will be designed and that the system will be used for information exchange between the organization such as universities or libraries and TV conferences.

Second, we will examine the system parameters. The frequency band to be used will be the 50/40 GHz band and the transmission data rate will be 64 kbits/s. The system will have two channels; one common channel, to provide point-to-multipoint communication such as TV conference, and another for point-to-point communication for inquiry and/or personal use. With

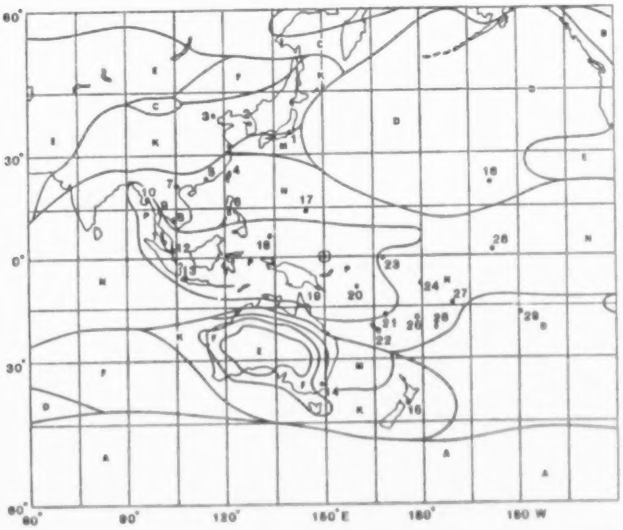

Fig. 3. Climatical classification in Asia-Oceanian region.

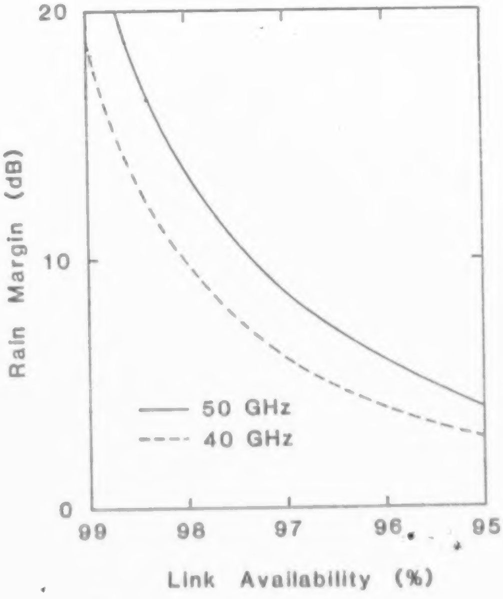

Fig. 4. Rain margin in Angaur.

Table 2 Link Budget for Regional Communication

		Up Link 50 GHz	Down Link 40 GHz
Tx. Power	(W)	0.5	0.25
Antenna Diameter	(m)	0.3	0.8
Antenna Gain	(dB)	41.7	46.5
Feeder Loss	(dB)	-0.7	-2.0
E.I.R.P.	(dBW)	38.0	38.5
Path Loss	(dB)	-217.8	-215.9
Rain Attenuation (Link Availability 95%)	(dB)	-4.0	-2.8
Atmospheric Loss	(dB)	-2.1	-0.5
Antenna Diameter	(m)	0.8	0.3
Antenna Gain	(dB)	48.5	39.8
Feeder Loss	(dB)	-2.0	0.7
Rx. Power	(dBW)	-139.4	-141.6
Tsys	(K)	950	550
No	(dBW/Hz)	-198.8	-201.2
C/No	(dBHz)	59.4	59.6
Total C/No	(dBHz)	56.5	
C/No needed (MSK ; Bit Error Rate : 10^{-4} ; Data Rate : 64 kbits/s)	(dBHz)	56.5	

an earth station antenna of a 0.3 m-diameter, the link-budget for the system is shown in Table 2. The output power of the transponder is assumed to be 0.25 W/channel in Table 2, because 0.5 W output-power for 2 channels from the FET Solid State Power Amplifier (SSPA) will be available in a few years. The FET-SSPA has good linearity and is suitable for multi-carrier operation. Table 2 shows that an on-board 0.8 m-diameter antenna is sufficient to establish the communication link. Since the beam width is approximately 0.6 deg., a multi-beam antenna has to be used to cover the large service area. In Table 2, the link margin is 0 dB. However, with an FEC technique, we can achieve a link margin of approximately 5 dB.

Third, we assume that transponder, serving approximately 10 beams, will be use clustered FET-SSPA of 0.5 W output-power. An example of the transponder configuration is shown in the next section.

3.3 System Configuration

In this section, an example of the system is shown. We selected the regions, where the 9 campuses of the University of South Pacific are located, as the service areas. They correspond to cities No. 20-27 and 29 in Table 1.

Figure 5 shows the beam coverage of the on-board multi-beam antenna. The satellite location is assumed to be 150 deg. east longitude, allowing for the possibility of extending beam coverage to the whole Pacific area. In this case, the width of a beam is 0.6 deg. and the beam deviation angle to the antenna axis is 3.5 deg.

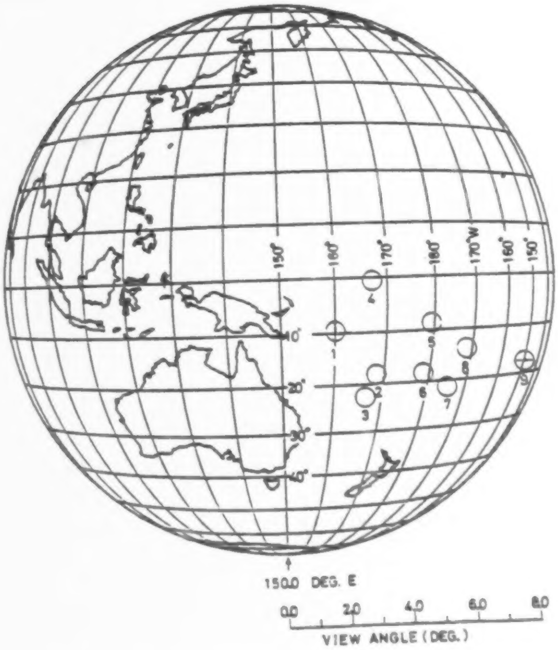

Fig. 5. Beam coverage of on-board antenna.

The channel allocation is shown in Figure 6. The uplink has 10 channels, which consist of 9 channels (B1-B9) for point-to-point communication and one channel for common signalling. The transmitting region can be distinguished by 9 channel-frequencies corresponding to each service region. The downlink has only 3 channel-slots, to simplify the configuration of transmitters and reduce noise by narrowing the bandwidth. The downlink communication channel uses either of the two channel-frequencies so that co-channel interference is avoided in adjacent service areas.

Figure 7 illustrates the proposed transponder configuration and Table 3 shows the parameters of transponders. The mission equipment weight is less than 90 kg and consists of a 0.8 m-diameter antenna and 9 40 GHz 0.5 W output-power SSPAs. Since the mission equipment is small and light, it can be mounted in any satellite or a geostationary platform in the future.

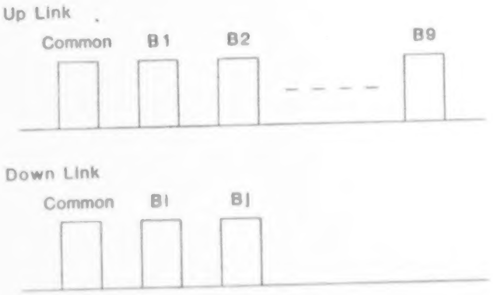

Fig. 6. Channel allocation.

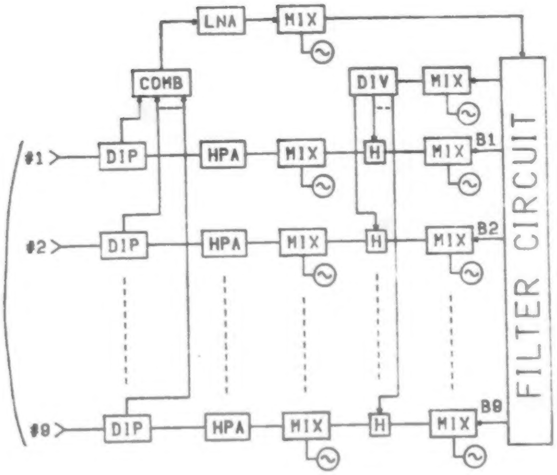

Fig. 7. Transponder configration.

3.4 Technological Development Items

There are many technical areas which need to be developed in order to realize the millimeter-wave communication system described above. In this section, we discuss some of the principal development areas and prospects for their development [5].

Solid State Power Amplifier (SSPA): SSPA with high output power, high gain, high efficiency, high linearity and light weight should be developed. However, considering the current state-of-the-art, 0.5 W output power amplifier in 40 GHz band using GaAs FET can be developed.

Low Noise Amplifier (LNA): Millimeter wave LNAs with a noise figure of about 4.5 dB at 40 GHz and 5.0 dB at 50 GHz have to be developed.

High Stability Local Oscillator: In Single Channel Per Carrier (SCPC) communication systems, high transmit frequency stability is required. In such cases, we need to use a crystal oscillator as a local oscillator. In order to multiply the oscillated frequency to the needed frequency, we can use a Phase Locked Oscillator (PLO). Recently, a PLO with a frequency stability of 3×10^{-7} or less in temperature of -10°C - +40°C has been manufactured.

Antenna Technology: In the millimeter-wave communication service, we must develop an on-board multi-beam antenna with high efficiency. Furthermore, an antenna pointing mechanism will be needed to maintain the beam to about 0.02 deg. or less.

Table 3 Transponder Performance Summary

Frequency Operation		50/40 GHz
Number of Channels		10 ch
Channel Bandwidth		200 kHz
Output Power	more than	0.5 W
Input Noise Figure	less than	6 dB
Weight (including Antenna)	less than	90 kg
Power Consumption	less than	400 W

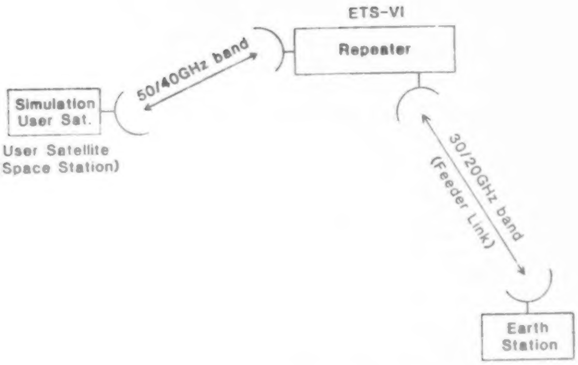

Fig. 8. Configration of inter-satellite communication experiment.

Small Earth Station: In order to achieve a millimeter-wave communication system, the development of the small inexpensive earth station is necessary.

4. EXPERIMENTAL SYSTEM

An experimental inter-satellite communication system using the Engineering Test Satellite-VI (ETS-VI) is now under study in Japan. The ETS-VI is scheduled to be launched in 1992. Figure 8 shows the proposed configuration of a millimeter-wave inter-satellite communication system as an experiment using ETS-VI. The millimeter wave of 50/40 GHz band is used for the link between a user satellite and the ETS-VI. As the antenna for inter-satellite communication is mounted on a gimbal platform, it is possible to carry out satellite communication experiments between any point in the Asia-Oceanian region and a feeder link earth station in Japan. Communication experiments in the Asia-Oceanian region will be also possible. Therefore, preliminary experiments on the above-mentioned system might be carried out using ETS-VI.

Until ETS-VI is launched, it would be very useful to collect and analyze rainfall data in the Asia-Oceanian region. For that purpose, we should investigate use of a data collection/communication system using an existing satellite, such as a geostationary meteorological observation satellite.

5. CONCLUSION

This paper has described the considerations for a millimeter-wave satellite communication system for the Asia-Oceanian region. We have shown; (i) the technical possibility of establishing a simple satellite communication system, (ii) the applicability of millimeter-wave to the Asia-Oceanian region, and

(iii) the method of experimentation. It is the most important that we continue our effort to implement the study of such a millimeter-wave satellite communication system as a simple communication system for the Asia-Oceanian region in more detail.

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KU-BAND SMALL APERTURE EARTH STATIONS FOR COST EFFECTIVE COMMUNICATIONS

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ABSTRACT

Small aperture earth stations are a reality today providing enhanced telecommunications services to a broad spectrum of users. This paper will discuss some of the relevant technologies, architectures, and applications of small aperture earth stations.

Small aperture earth station networks for voice, data, and image communications are a reality today. Incorporating the latest state of the art technology including the use of Gallium Arsenide (GaAs) in semiconductor chip design, the small aperture earth station is providing a low cost alternative to existing and nonexistent terrestrial communications services. Many experts are predicting that this new technology is the forerunner of corporate telecommunications operations in the era of the integrated services digital network (ISDN). As an example, in the United States today, thousands of small aperture earth stations are operating in the C and KU bands providing enhanced digital telecommunications services. In some instances, the use of small aperture earth stations is providing the capability for communications services that previously were impossible to provide. In others, they are simply a way of providing a continuously available communications capability without the expenditure for an inefficiently used leased communications service.

The Ku and C band frequencies bands offer distinct communications advantages and disadvantages. The use of C-band transponders, for instance, requires larger antennas which tend to be more expensive and aesthetically less pleasing than Ku Band earth stations. C-band is commonly shared by satellite and terrestrial users so power radiated from the satellites is reduced to lessen terrestrial interference. The inherent advantage at C-Band is the signal is less susceptible to atmospheric attenuation. On the other hand, at KU band, there is less restriction of radiated power so the transponder effective isotropic radiated power (EIRP) is at least 15 dB stronger than at C-Band. The higher EIRP is, however, neutralized by the path loss when compared to C-Band. But, because of Ku-Band's shorter wavelength, smaller dishes can be used. A number of .75 meter to 2.4 meter antennas are now deployed throughout the United States.

The reason for the proliferation of small aperture KU and C band systems is twofold. First, small aperture terminals have become a practical communications solution because of a combination of reduced hardware and satellite transponder costs. Also, small aperture earth stations offer the advantage of tailor made networks with minimal impact on the environment, and are easy to install. Secondly, small aperture terminals provide an alternative to leased telephone lines and leased channels on private or public packet switched networks, thus providing the capability to handle a wide variety of traffic on a broadcast, receive-only, or point-to-point basis; and they require no connections to local or long distance carrier services.

The transmission speeds available in small aperture earth stations can be grouped into three categories: low speed-less than 9.6 Kbps; medium speed-9.6 to 56 Kbps; and high speed-56 Kbps to 1.544 Mbps. The distinction being that the cost of usage is insensitive to distance and the user can tailor its network requirements to specific communications requirements without the limitations of existing analog networks and the problem of the tail-end connections or the so called last mile.

Small aperture earth stations, as their name implies, also can come with very small price tags. Today, prices range from as low as $2,500 (U.S.) for a complete receive-only terminal to less than $25,000 for a transmit/receive earth station with voice, data, and image capability. When these costs are spread over (5) five years and combined with space segment and maintenance charges, the per terminal cost becomes about $350.00 per month.

The descriptive components that make up a small aperture earth station are: an antenna, microwave transceiver with various solid state power amplifiers, a modulator/demodulator with forward error correcting (FEC) channel coding and when voice is desired, a voice codex processor.

These earth stations are tied together in various architectures. The network architectures that are currently used are the STAR and MESH configurations. In the STAR method 10's, 100's or 1,000's of terminals are linked together through a large hub earth station. The hub earth station is usually larger than 5 meters with high power amplifiers and fully redundant electronics. Monitor and control of the network is done through the hub earth station. The hub communicates to all of the small aperture earth stations in a broadcast mode. The small aperture earth stations communicate directly back to the hub and seldom communicate with each other.

In the MESH configuration all earth stations have the capability to interact with all other earth stations in the network. In a point-to-point network, using 1.8 meter earth stations, you can effectively transmit a duplex 56 Kbps signal at a lower cost than a terrestrial 56 Kbps leased line. In large mesh networks, i.e., 5-20 earth stations, larger earth stations, e.g., 3.0 meters are normally used to reduce your recurring space segment charges.

The principal means of operation for the small aperture earth station is accomplished through the components at the earth station. In the small aperture terminal the microwave RF transceiver sits out at the antenna and the modulator/demodulator sits indoors connected to the RF by coaxial cable.

Each component within the small aperture terminal provides a certain function. The microwave transceiver down-converts the incoming signal from 12 GHz to 70 Mhz IF where it is then passed to the demodulator portion of the modem for conversion to the data or voice processor. On the transmit side, the modem modulator modulates the data or voice signal to 70 MHz IF which is then upconverted to 14 GHz and transmitted to the satellite. The ability to provide low cost solid state power amplifiers at 1, 2, 4, or 8 watts using semiconductor technology has been the primary driver in cost reducing these earth stations.

In an operational network there are many small aperture terminals attempting to use the same satellite. Because of this, some means must be provided for sharing the capacity from the small earth station to the large hub station. Since the transmission from the hub to the small aperture terminal is being broadcast to many locations, concern for space segment planning in this direction is not of utmost importance. The method used in sharing resources among many small terminals is the Multiple Access Architecture (MAA). The architecture used is determined by the traffic to be served and by the method of channelizing the satellite bandwidth.

All computer terminals generate data bits which occur in contiguous sequences. These sequences have random length and occur at random intervals in time. If the sequence length is short relative to the interarrival time, the traffic is sporadic, e.g., transaction traffic. If the data sequence is long relative to the interarrival time, the traffic is stream, e.g., facsimile. Packet switching applies to sporadic traffic, and circuit switching applies to stream traffic. The satellite bandwidth must be shared according to one of these fundamental switching schemes.

The satellite bandwidth is usually channelized according to time division, frequency division or code division (spread spectrum) methods of multiplexing. Packet switching is usually implemented by time or code division, and circuit switching is usually implemented by frequency division.

In the large hub earth station to small aperture earth station transmission direction, one carrier frequency on the uplink contains a multiplexed bit stream individually addressed to multiple earth stations. Hence, the uplink transmission from the hub is called a time division multiplexed channel (TDM).

From the small aperture terminal to the hub the access methods used include time division multiple access (TDMA) and frequency division multiple access (FDMA). Another form of TDMA is random access, e.g., "ALOHA". FDMA is commonly referred to as single channel per carrier (SCPC).

In the case of RA/TDMA, the full satellite channel data rate is shared on a random access basis among many users. In the SCPC mode, each user gets a dedicated channel. Under current conditions, SCPC operations usually support small numbers of users while RA/TDMA supports hundreds of users.

The design of the modem affects the network architecture and vice versa. For example, in RA/TDMA, the small terminal transmits bursts of bits at the full channel rate. To do this, the modem must obtain burst timing from a digital interface unit in conjunction with the packet transmissions. In the SCPC mode, the modem sends a continuous stream of bits at a data rate equal to the total satellite system rate divided by the number of SCPC small terminals.

At the hub station, RA/TDMA transmission requires burst reception by the modem. The TDM hub uplink requires continuous transmission at the full satellite channel rate. In SCPC, hub modems are the same as the small terminal modems, and operate continuously in receive and transmit modes.

There are many applications for these types of networks in developing countries. They include health, education and community development services. Other applications include data base inquiry and updating, credit verification, financial transactions, reservation systems, high speed facsimile transmission, videoconferencing, remote monitoring, and electronic mail to name just a few.

While the use of KU band technology has been accepted and is widely used in the United States today, the international market remains virtually untouched. There are, however, carriers emerging to exploit KU band service applications particularly within the Pacific Basin. Countries who have determined to provide KU band services include Australia, Papua New Guinea, and Japan. Of course INTELSAT is already exploiting such services. If the political barriers can be overcome, KU band earth stations could become the chosen satellite medium for the transmission of voice, video, and data due to its lower cost, efficiency, and greater flexibility.

Given the current technical capabilities, what then could be the impediments to fuller development of KU band services? The answer to that question lies in the way all international services, new carriers in particular, are confronted by the reluctance of overseas PTT administrations to correspond with new entities.

In conclusion, applications of a satellite system are diverse, but the one factor most in common is the need to move data, voice, and image quickly between far flung locations at minimal cost. Small aperture earth stations are now providing this capability.

Proposed Telecommunications Network Architecture In Pacific Ocean Region

- Satellite Communications System Using Micro Terminals -

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Abstract

Satellite communications systems have a potential merit that users can directly communicate with each other by using earth stations installed at their premises through geostationary satellites without using subscriber lines. The micro-terminal satellite communications system, in which 1- to 2-meter diameter antennas are used, is one of those systems which can make the most of the merit mentioned above. This kind of micro-terminal system can especially provide a private communication system in a simple and economical way and will be extensively used in the future on a world-wide basis.

1. Introduction

Today telecommunication systems using geostationary satellites are widely used for international, domestic and regional telecommunication purposes.

Such satellite communications systems have great advantage over other systems such as submarine cable systems and terrestrial microwave network systems in that not only point-to-point mode communication but also point-to-multipoint or broadcast mode communications can easily be provided.

In the past few years, satellite communications systems using small earth stations installed at customer's premises have been put into practical use by virture of the increased satellite G/T and down-link power.

KDD is now developing an economical satellite communications system using micro-terminals equipped with 1- to 2-meter diameter antennas. The system which is called the micro-terminal system could provide a direct both way communication between micro-terminals.

This paper presents outlines of the proposed system including the comparison between the system and similar applications in the INTELSAT systems.

2. Merits of the micro-terminal system

Micro earth stations can easily be installed at customer's premises and end users can communicate directly with each other using micro-terminals through satellite(s). Therefore, there are following merits in the micro-terminal system compared to currently used satellite communication systems in which earth station antennas of large size are used.

(1) Neither terrestrial nor subscriber lines are needed,

(2) Earth Stations are small and easy to install, and

(3) Earth stations are of simple configuration and of low cost.

These features would bring the following effects in service offerings:

(1) When end users ask for a new circuit, direct communication links between end users can easily be established within a short time since no terrestrial lines between earth stations and end users are needed.

(2) Temporary circuits can easily be provided in the case of disasters and unexpected events.

(3) Even in the place where terrestrial lines are not developed well or it is very difficult to establish terrestrial lines, this system can easily be introduced.

(4) New digital services including voice, data and video signals can easily be handled because digital transmission lines up to 64 kbps as the maximum information rate can easily be established. This system would contribute to the spread of new information services using digital transmission lines.

3. Proposed network architecture

3.1 Network configuration

The proposed network comprises micro-terminals, central hub stations(s), satellite(s) and monitoring station(s) as shown in Figure 1. The network is in principle of a double hop system. In the case, however, where both micro-terminals are located in the same coverage area of a satellite, the links among those terminals can also be established in a single hop configuration by user's selection. If a double hop configuration is taken, a global communications network can be provided. Namely, direct communication is possible between most micro-terminals located anywhere in the world by taking a double hop configuration.

As an access method, a single channel per carrier (SCPC) based on a Frequency Division Multiple Access (FDMA) is employed. Channels are assigned principally based on a demand assigned method, but channels can also be assigned based on a preassigned method.

Main functions of the central hub station and the monitoring station are as follows:

(1) Central hub station

- channel assignment,
- relay of the information,
- connectivity exchange among micro-terminals,
- transmit carrier power control,
- monitoring of frequencies and powers of carriers emitted from micro-terminals,
- charging, and

(2) Monitoring station

- monitoring of frequencies and powers of carriers emitted from the central hub station.

In the case of double-hop configuration, a channel is assigned at the central hub station responding to the request from a micro terminal. Then a carrier emitted from the micro-terminal is received at the central hub station through a satellite and retransmitted by using the same modulation method as that of the first hop link (micro-terminal to central hub station) from the hub station to a receiving micro-terminal through a satellite. In this case, if the transmitting and receiving micro-terminals are not located in the same service area of a satellite, another set of hub station and satellite will be used on the second hop link.

In the case where a transmitting and receiving microterminals are located in the same service area of a satellite, a single-hop configuration could be taken under the clear sky condition to reduce the required satellite bandwidth. Namely, after a channel is assigned at the central hub station responding to the request from a micro-terminal, a direct communication link is set up without being relayed by a central hub station.

The proposed system will be designed to make any connections among micro-terminals possible, but will be inhibited from making any connections to public switched networks.

3.2 Main characteristics and link budgets of the system

Main characteristics and link budgets of the system are shown in Table 1 and Table 2, respectively. In Table 2, link budgets are shown for two cases, i.e. double-hop configuration and single-hop configuration, assuming that a 14/11 GHz spot beam transponder of the INTELSAT V is used. These link budgets have been calculated for the micro-terminal with a 1.8m diameter antenna at the beam edge, however, a 1.2m diameter antenna can be used at the beam center.

Antenna sizes and transmit powers required for microterminals are different depending on locations of the terminals and availability objectives required for communication links. In the case where a micro-terminal is placed at the beam edge area of the satellite or severe rain attenuation is expected at the predetermined time percentage of the year, a larger antenna and/or transmit power are required.

In the micro-terminal system, side-lobe characteristics of the micro-terminal should be as low as possible in order to overcome interference problems between this system and the terresrial networks or other satellite systems. In the proposed system, 10 dB more stringent side lobe characteristics compared to those of CCIR Recommendation would be realized.

In the initial stage, 14 and 11 GHz beam transponders of INTELSAT V, V-A and VI satellites will be used. In order to expand service areas, however, the use of 6 and 4 GHz frequency bands will also be considered in the future. In such a case, the size of a micro-terminal will be larger than that of a micro-terminal which is used in 14 and 11 GHz frequency bands.

3.3 Channel assignment

Channels are assigned in principle based on a demand assignment method in order to utilize transponders efficiently.

The transmitting micro-terminal requests a channel assignment to the central hub station through a request channel which is provided based on a random access method of ALOHA-type.

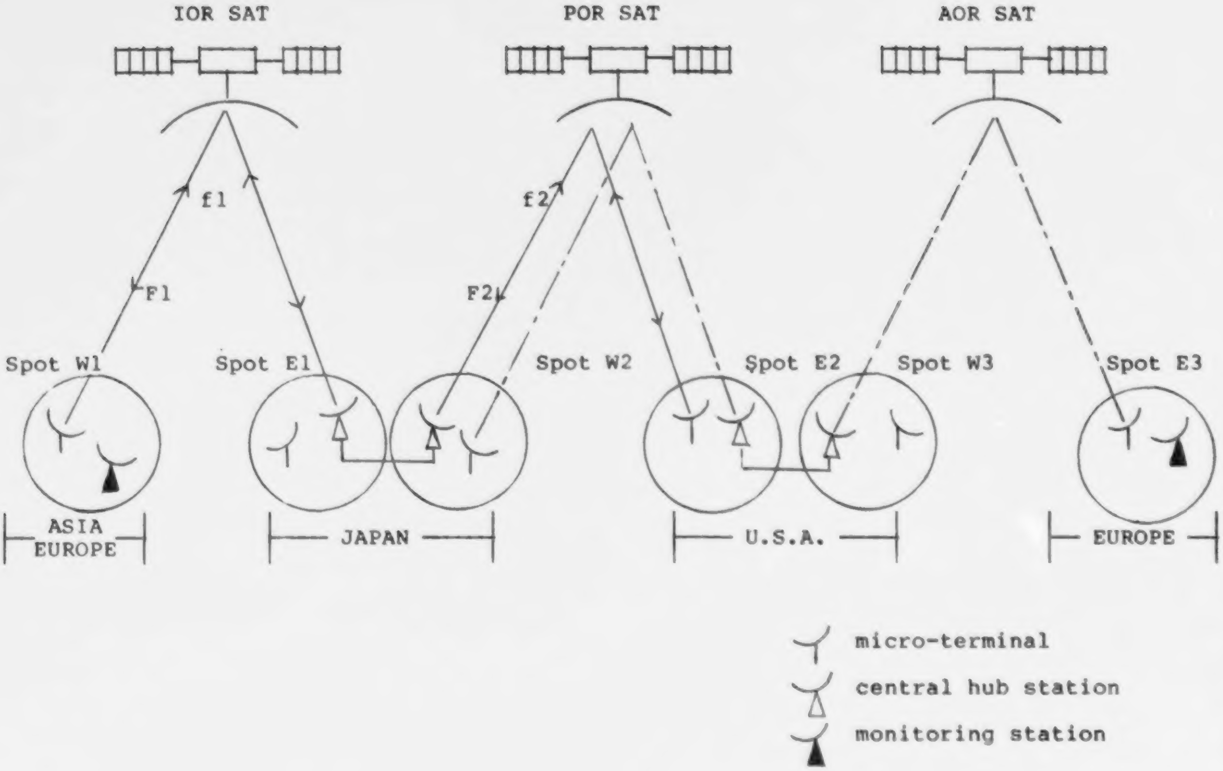
IOR SAT
POR SAT
AOR SAT
f1
F1
f2
F2
Spot W1
Spot E1
Spot W2
Spot E2
Spot W3
Spot E3
ASIA
EUROPE
JAPAN
U.S.A.
EUROPE
micro-terminal
central hub station
monitoring station

Figure 1 PROPOSED NETWORK CONFIGURATION USING MICRO-TERMINALS

Table 1 MAIN CHARACTERISTICS OF MICRO-TERMINAL SYSTEM

Items	Characteristics
frequency	14/11 - 12 GHz (1st generation) 6/4 GHz will be used at the 2nd generation system
satellite	INTELSAT V, V-A, V-B and VI
channel assignment	demand assignment using random access by ALOHA type
modulation and access method	BPSK/FDMA
information bit	16 kbps, 32 kbps, 64 kbps
error correction	rate $\frac{1}{2}$ convolutional coding and sequential decoding
central hub station	antenna diameter = 8 m, G/T = 34.0 dB/K
monitoring station	antenna diameter = 3.5 m, G/T = 25.0 dB/K
micro-terminal	antenna diameter = 1.2 m/1.8m, G/T = 17.1 dB/K / 20.6 dB/K transmitter = 2W SSPA

In the double-hop configuration, the central hub station assigns different channels (F1, f1, F2 and f2) to the link between the transmitting micro-terminal and the hub station and the link between the hub station and the receiving micro-terminal, respectively. The receiving micro-terminal can be identified using a terminal identification code included in the request channel. If the transmitting and receiving micro-terminals are so located that the both cannot be covered by a single satellite, the channels f1 and f2 are assigned on the separate satellites. In this case, two hub stations are required, which are connected with each other directly or via a land line.

In the single-hop case, a single channel is assigned to the direct link between the transmitting and receiving micro-terminals.

3.4 Automatic carrier power control

In the double-hop system using 14 and 11GHz frequency bands, an automatic carrier power control will be conducted in the second link from the central hub station to the receiving micro-terminal to compensate for the carrier level attenuation due to rain. This carrier power control is made on a carrier by carrier basis. In the first link from the transmitting micro-terminal to the central hub station, it is not necessary to control the carrier power because the G/T in the down link is large and thus enough system margin can be obtained.

In the single-hop system, the carrier power control will not be used due to the restriction of the transmitter power of the micro-terminal.

4. Application

The typical use of this micro-terminal system is in the following point-to-point communication and point-to-multipoint distributed data base applications:

(1) Data distribution mode

This mode is used for distribution of data from a central hub station to many micro-terminals.

(2) Data collection service

This mode is used for collection of data from many micro-terminals to a central hub station.

(3) Both way transmission mode

This mode is used for interactive communications between two micro-terminals.

These three modes will be applied to the following service with the information rate up to 64 kbps:

(1) Data transmission

(2) Computer-to-computer communication

(3) G-IV FAX transmission

(4) Voice transmission

(5) Picture phone transmission

By using the computer-to-computer communication service mode, personal computers or remote computers terminals can easily access to data processing centers.

Recently KDD has developed the "INVITE 64" (Integrated Visual Telecommunication) system which enables the transmission of the combined signal of picture and voice at 64 kbps information rate. By incorporating this system in the picture phone transmission service mode, a teleconference between two remote sites can easily be implemented.

5. Comparison between the proposed system and similar applications in the INTELSAT system

In the current INTELSAT system, INTELNET service and IBS are offered as services using small earth stations.

In the INTELNET service, communication between micro-terminal and hub station is contemplated by using spread spectrum signals or BPSK signals, but direct communication between micro-terminals is not possible.

In the IBS, although direct business communication between earth stations is possible, the minimum antenna size of earth stations is about 3.5 meters.

Comparison between the proposed micro-terminal system and the two similar applications in the INTELSAT system to date is given in Table 3.

6. Conclusion

The micro-terminal system which can provide economical satellite communications has been described.

In order to realize such a system, technical matters described below must be studied and developed.

(1) Micro-terminal antenna of which side-lobe level is substantially lower than that recommended in CCIR,

(2) Charging system,

(3) Carrier assignment system applicable to the double-hop system as well as the single-hop system, and

(4) Automatic carrier power control system

KDD is now proceeding with such studies and development aiming at application in the INTELSAT system in the near future.

Since the proposed micro-terminal system enables customers to access medium-speed digitalized networks in a simple way, it would play a role similar to the Integrated Services Digital Network (ISDN).

Table 3 COMPARISON BETWEEN THE PROPOSED SYSTEM AND SIMILAR APPLICATIONS IN THE INTELSAT SYSTEM

	Proposed system	INTELNET	IBS
frequency (GHz)	14/11, 12	6/4 & 14/11	6/4 & 14/11, 12
size of user gateway station	1.2 - 1.8 m	0.6 m - 1.5 m	3.5 m - 9 m
direct communication between user gateway stations	possible	not contemplated	possible
channel assignment	demand assignment	preassignment	preassignment
modulation method	BPSK	SS, BPSK	QPSK
max. information rate	64 kbps	9.6 kbps (SS) 64 kbps (BPSK)	8 Mbps

PANEL

"Government, Suppliers' and Users' Perspectives on Arriving at International Standards Agreements: Views from Japan and the U.S."

Notes

Rapporteurs' Summary and Closing Remarks

Notes

Table 2 (a) LINK BUDGET FOR DOUBLE HOP CONFIGURATION

(2nd Hop; hub station to micro-terminal)

UPLINK	
Transmit frequency	14.00 GHz
HPA power (Saturation)	33.00 dBW
HPA Output Backoff	18.31 dB
Antenna Diameter	8.00 m
Antenna Efficiency	0.70
Feed loss	0.50 dB
Pointing loss	0.10 dB
E.I.R.P. (Operation)	73.93 dB
Path loss	207.10 dB
Rain loss uplink	0.00 dB
Saturation Flux Density	-80.30 dBW/m
Satellite G/T	3.30 dB/K
Input Backoff/Carrier	28.11 dB
Input Backoff/Transponder	8.50 dB
C/No Uplink Thermal Noise	79.12 dB-Hz
C/Io Frequency Reuse	78.07 dB-Hz
C/(No+Io) Uplink	75.55 dB-Hz
DOWNLINK	
Transmit Frequency	11.00 GHz
Satellite E.I.R.P. (beam edge)	41.10 dBW
Output Backoff/Carrier	23.61 dB
Output Backoff/Transponder	4.00 dB
Path loss	205.30 dB
Rain loss downlink	1.53 dB(1)
Antenna Diameter	1.80 m
Antenna efficiency	0.67
System Noise Temperature	334.20 K
E/S G/T	19.26 dB/K
C/No Downlink Thermal Noise	58.52 dB-Hz
C/Io Frequency Reuse	78.07 dB-Hz
C/Io Intermodulation	65.57 dB-Hz
C/(No+Io) Donwlink	57.70 dB-Hz
Loss due to External Interference	1.20 dB
C/(No+Io) TOTAL	56.43 dB-Hz
C/(N+I) TOTAL/128 kHz	5.36 dB(2)

(1) Rain loss is less than 1.53 dB for 99.5% of a year.

(2) The threshold C/N for the bit error rate of 10^{-6} is 5.36 dB which is the sum of the theoretical C/N (0.66 dB), various margins (3.7 dB) and power control uncertainty (1 dB).

Table 2 (b) LINK BUDGET FOR SINGLE HOP CONFIGURATION

(micro-terminal to micro-terminal)

UPLINK	
Transmit frequency	14.00 GHz
HPA power (Saturation)	3.00 dBW
HPA Output Backoff	1.00 dB
Antenna Diameter	1.80 m
Antenna Efficiency	0.67
E.I.R.P. (Operation)	48.64 dB
Path loss	207.10 dB
Rain loss uplink	0.00 dB
Saturation Flux Density	-80.30 dBW/m
Satellite G/T	3.30 dB/K
Input Backoff/Carrier	33.79 dB
Input Backoff/Transponder	13.79 dB
C/No Uplink Thermal Noise	73.44 dB-Hz
C/Io Frequency Reuse	78.07 dB-Hz
C/(No+Io) Uplink	72.15 dB-Hz
DOWNLINK	
Transmit Frequency	11.00 GHz
Satellite E.I.R.P. (beam edge)	41.10 dBW
Output Backoff/Carrier	27.80 dB
Output Backoff/Transponder	7.80 dB
Path loss	205.30 dB
Rain loss downlink	0.00 dB
Antenna Diameter	1.80 m
Antenna efficiency	0.67
System Noise Temperature	251.00 K
E/S G/T	20.50 dB/K
C/No Downlink Thermal Noise	57.10 dB-Hz
C/Io Frequency Reuse	78.07 dB-Hz
C/Io Intermodulation	72.29 dB-Hz
C/(No+Io) Donwlink	56.94 dB-Hz
Loss due to External Interference	1.20 dB
C/(No+Io) TOTAL	55.61 dB-Hz
C/(N+I) TOTAL	4.54 dB(1)

(1) The threshold C/N for the bit error rate of 10^{-6} is 4.36 dB which is the sum of the threshold C/N (0.66 dB) and various margins (3.7 dB).